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Water-Power Development of the Southern Aluminium Co., Near Whitney, N. C.

EARLY VICISSITUDES—The large water-power development of the Southern Aluminium Co., near Whitney, N. C., is of unusual interest, not only because of its magnitude but also because of the elaborate and costly work which was done under a previous administration and which has been discarded in favor of a later and more comprehensive plan. The commercial value of the Yadkin River Narrows, in Stanley County, has long been known. In 1901, the late George Whitney, of Pittsburgh, was the promoter of a concern which undertook the development here. The project passed into the hands of the North Carolina Electric & Power Co., which proceeded with unusual and expensive plans. The first work was the construction of a six-mile spur track from the nearest railroad point to the place on the river selected for the dam site. Here, the town of Whitney was located as headquarters for the project; it is about 30 miles east of Salisbury, N. C. The company did a great deal of construction work on the dam and power canal, the latter having been practically completed before work was stopped. It was then reported that some $6,000,000 had been sunk.

The old dam is of granite ashlar, 38 ft. high and about 1000 ft. long in the main portion. It is built straight across the channel with a wing extending at right angles downstream to act as a retaining-wall for the upper end of the canal. The dam was apparently about 75% completed when work was discontinued; judging from the appearance of the ends of unfinished portions and of the massive cut-stone face blocks, it is a fine piece of masonry construction. The canal is 40 ft. wide at the bottom and about 18 ft. deep; it is excavated largely through rock and extends about 4½ miles down stream. The net head of water above the power-station site was to be 120 ft. and this was expected to furnish 45,000 hp.—though for only some 12 hr. per day.

After the failure of the old company, following the financial stringency of 1907, the property was bought in by the present owner, the Southern Aluminium Co., a French concern, which was reported to have been heavily interested in the old power company. It was announced that the development would be completed and a large aluminum industry established. Even contracts were let for seven vertical turbine-driven direct-current generating units which were to have been the largest of that type ever built (5000 kw., 25 volt, 20,000-amp., 170-r.p.m., weighing 150 tons; see ENGINEERING NEWS, Nov. 7, 1912, p. 845).

Later these orders were canceled, as a study of the situation by the new company's engineers brought radical departure from the old plans. This involved abandoning all the old construction and building a new high dam at

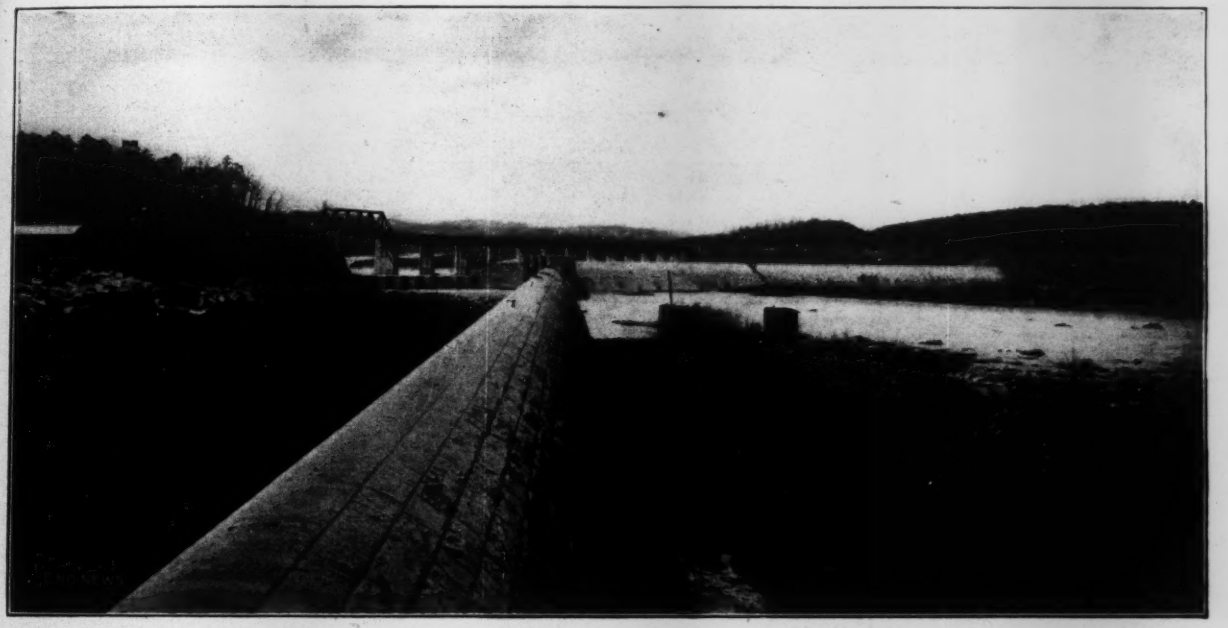


FIG. 1. THE OLD WHITNEY DAM; ABANDONED AND TO BE SUBMERGED

the Narrows about five miles downstream. The reasons for this move are obvious. The construction of a high dam and the location of the power station immediately below it obviates the necessity for a long canal with its incidental losses of water by seepage and evaporation, loss of head, and maintenance cost. The new dam will have anchorage in solid rock at both ends, while the old dam is built across a flat plain and joins an earth embankment at one end. The most important advantage, however, is the vastly increased water storage that will be afforded by the new dam, which will create a reservoir to cover about 8 sq.mi. and submerge the old dam to a depth of from 4 to 10 ft. This has an important bearing in the case of such an electrolytic industry where cheap power must be had and where the works can be run 24 hr. per day to bring the load factor up and the unit cost down.

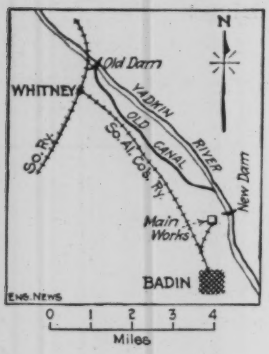


FIG. 2. SKETCH MAP OF OLD AND NEW HYDRO-ELECTRIC WORKS NEAR WHITNEY N. Y.

THE NEW DAM—The proposed dam is to be of concrete, with about 33% of large boulders embedded, varying in size from one-man stones to 5 and 6 cu.yd. each. It will be about 200 ft. high above bedrock at deepest point, with a gravity section, having a batter on upstream face of 1 in. in 10 ft. In plan, the dam will be curved with convex face upstream; the radius at top face will be 1660 ft. and length of dam at top, 1350 ft. The maximum base width will be 160 ft. and the contents will aggregate some 360,000 cu.yd. of concrete.

There will be no spillway as ordinarily understood. Flood water will be bypassed through two 900-ft. tunnels which have been built at the east end of the dam to divert the river during construction. These are 40 ft. wide by 34 ft. high and have a carrying capacity for maximum flood flows. They will be fitted with gates and used for all excess flow and for draining the reservoir.

On radial lines directly through the dam are to be several circular passageways for emergency gates, etc. While definite data of the design are not available, yet it is known that these passages will be of sufficient size to admit a dinkey locomotive and it is proposed to haul train loads of material through one or more during construction. The crest of dam will be at elevation 545, high-water line at elevation 533; low-water elevation is 350, and effective head over wheels, 175 ft.

The power station will be immediately below the dam; it will be of concrete 60 ft. by 580 ft. with longitudinal axis parallel to the stream. The first installation will comprise five double-wheel direct-current units, each of 5200 kw. capacity. There will be one single-wheel alternating-current unit of 1200 kw. capacity. It is proposed ultimately to increase the total equipment to 16 direct-current units (each 5200 kw.) and two alternating-current units (1200 kw.).

The forebay will be at one end of the dam (opposite the bypass tunnels) and penstocks will descend to the station in a 90° curve (horizontal projection).

INDUSTRIAL WORKS—The main furnace building for the reduction of bauxite ore will be located just above the west end of dam at elevation 734. The site covers an area about 600 ft. square, and the grading, on a rocky hillside, involves a great amount of work. On account of the rugged nature of the locality some heavy cutting is required, the spoil being used to fill lower portions of site. A feature of the construction for the aluminum reduction works is the use of vertical 15-in. I-beams, spaced about 20 ft. apart each way over the filled-in part of the site. They rest on concrete pedestals. In making the fill, practically all of them have been bent out of position, some as much as 2 to 3 ft. This is not considered

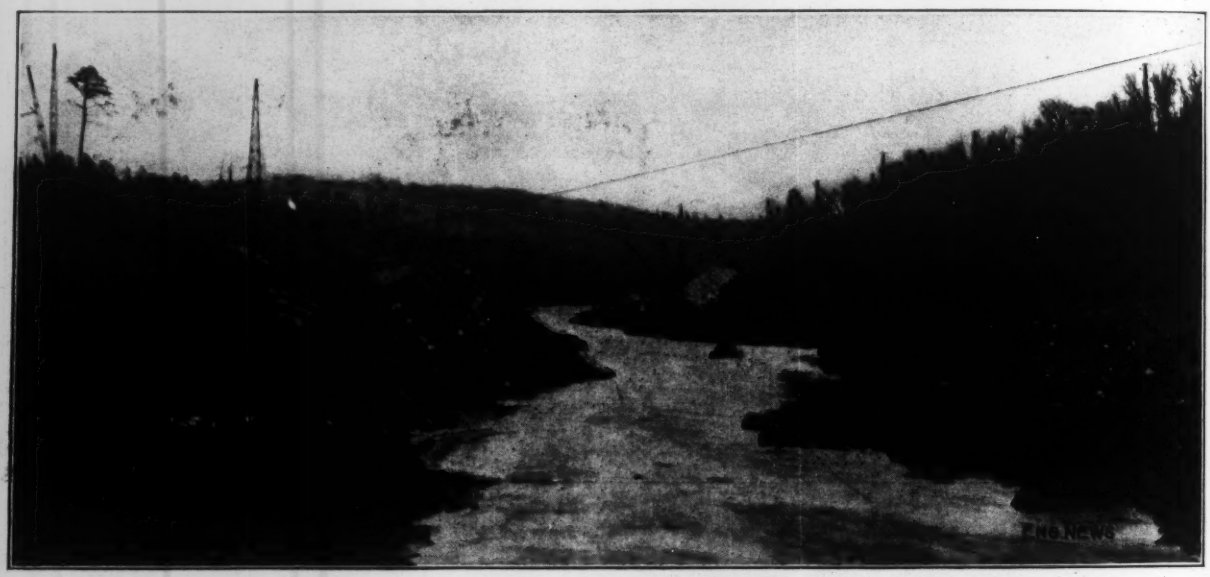


FIG. 3. SITE OF NEW DAM FROM ABOVE
(Tunnels at left; part of diverting bulkhead at right.)

important evidently as it is proposed, on completion of the fill, to run new columns down from floor level to connect with these, the tops of which will then be connected by reinforced-concrete beams.

This plant will be reached by a spur track from Badin, about 1½ miles distant. Since the site is much higher than Badin, there will necessarily be some heavy gradients to climb, some of them as much as 5%. The reason stated for selecting such an elevated site for the main works is that it is the only available one in close proximity to the power station. The main furnaces will be operated by direct current and it is essential that the transmission be as short as possible.

The headquarters of the enterprise will be located at Badin where it is proposed to build a model industrial

FIG. 6. CONCRETE-MIXING PLANT FOR BADIN DAM

FIG. 4. NEW STATION SITE FROM BELOW

FIG. 5. OUTLET OF YADKIN OF DIVERSION TUNNELS

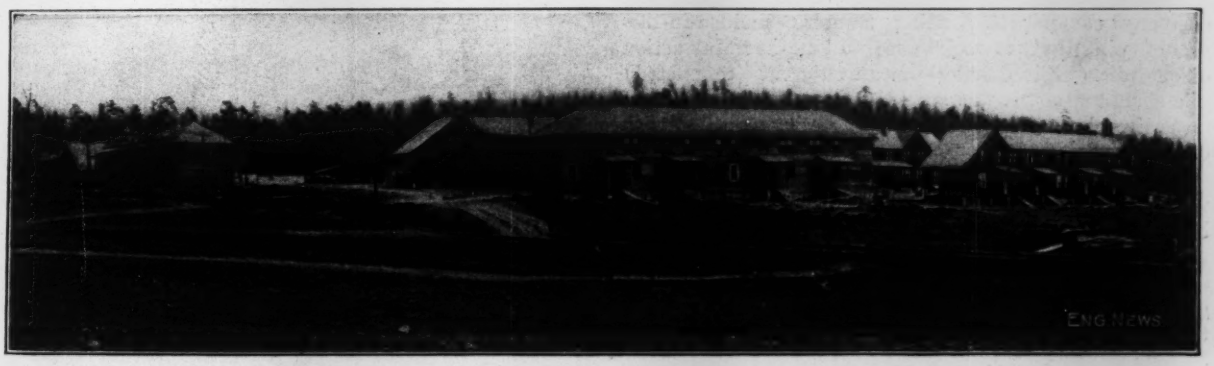


FIG. 7. TYPICAL WORKINGMEN'S HOUSES UNDER CONSTRUCTION; NEW INDUSTRIAL TOWN OF BADIN, N. C.

town. The general offices of the company will be located there, also the electrode plant (auxiliary to the aluminum works), repair shops, warehouses, foundries and aluminium rolling mills; these will be operated by alternating current. A brick office building has already been erected in Badin besides employees' quarters and a clubhouse and hotel for the use of officers and employees. Contracts have been let for the dweellings of workmen who will be employed in both plants. The houses will be built four to a block, each to have 4, 5 or 6 rooms and a bath. The buildings will be of wood with asbestos roof shingles. Enough buildings will be constructed to house 1000 workmen and it is estimated that there will be a total population of about 3000 people when the works are first put in operation. The town will be provided with water-supply, lighting and sewer systems. The buildings were designed by a well known architect of New York, after a study of the local situation. The arrangement and style of architecture resemble somewhat those used in English model industrial towns. This place is named after the president of the aluminum company.

ORGANIZATION.—The Chief Engineer and Vice-President of the Southern Aluminium Co. is P. Bunet; W. P. Marseilles is General Manager having general supervision of the work. Both are French engineers. The work is being done by the Hardaway Contracting Co.,

of Columbus, Ga., under B. H. Hardaway, President, and T. A. Jamison, General Manager. The force numbers 1200 men; there is in use a large amount of special equipment like the thirty 20-ton steel derricks with 115-ft. masts and 100-ft. booms. The miscellaneous plant comprises twenty-five 40-hp. hoists, two 20-ton locomotive cranes, seventeen 40-ton dinkey locomotives, 38 air-dump cars, twenty-five 50-ton standard steel flat-cars and four steam shovels. There are about five miles of construction track over the work. The concrete plant, including rock crushers, mixers, etc., is operated by electric motors; derricks and rock drills use compressed air from an electric compressor station. About 4000 hp. is used on the work, being furnished by the Southern Power Co., which has run a transmission line in from Albemarle, N. C. The work on the tunnels was sublet to Rhinehart & Dennis, railroad contractors of Washington, D. C.

A New Type of Concrete Pile

In both Great Britain and this country there has recently been developed a new type of concrete pile, the essential feature of which is the grouting of a precast concrete pile into a previously driven hollow tube. So far as we know the two developments have been independent, so a separate description of each is given below.

American Pile

A useful concrete pile construction was employed in the foundations of viaduct structures of the Lake Erie & Eastern Ry., at Youngstown, Ohio. The line is not yet completed, nor are the structures all finished, but the foundations, piers and walls, etc., are in, as well as much of the superstructure work.

The new piles were offered as the result of an unusual requirement on the part of the railway company. The company contemplated using Simplex molded-in-the-ground piles, but, to make sure that no harmful action of one pile (while driving) on an adjacent (completed) pile should occur, it was specified that all pile-casings of an entire pier must be driven before any was filled with concrete.

Remarkably high pile loading was to be used—40 tons working load per pile. Because of this, it was desired to have full assurance as to the condition of each pile.

To meet this requirement, an ingenious modification of the Simplex pile was offered, under guarantee of 25% greater load-capacity. It was accepted—subject to proof-test—and was used throughout the work, on the basis of 50 tons working load. The tests turned out satisfactory.

The piles were made by driving the usual straight Simplex casing with heavy driving-point; the casing diameter was 20 in., the depth of driving 22 to 28 ft. Then a mass of concrete was dropped in, to make a bed at the bottom of the pile; upon this was lowered a premolded and fully hardened reinforced-concrete pile or insert, octagonal in shape and of such size that it just fitted inside the casing. The reinforcing rods, projecting from the bottom of the insert, entered the soft concrete previously dropped into the casing, and thus bonded the insert in. Finally, cement grout was poured into the narrow space between casing and insert, and at the same time the casing was pulled, so as to let the grout flow into the void left by the casing and close all spaces between the reinforced-concrete insert and the surrounding earth.

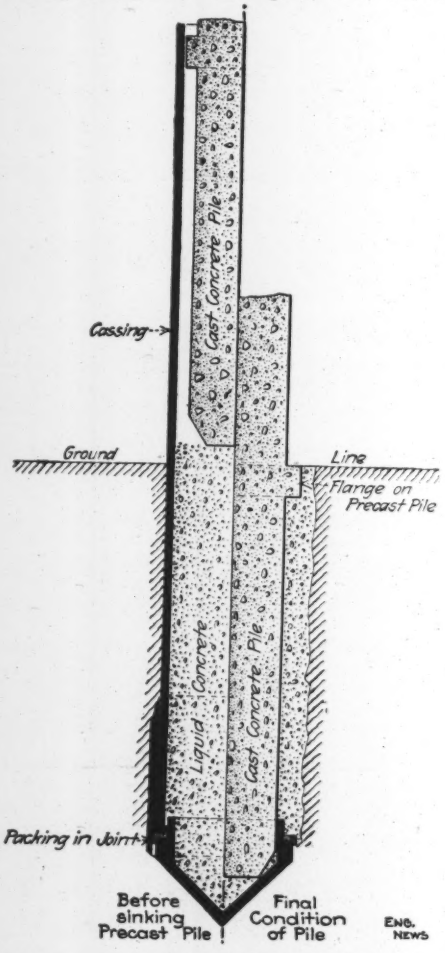
The character of ground and the depths were known well enough that the insert-piles could be molded to the necessary lengths, so that cutting off after completion was generally not necessary.

Tests of finished piles were made by loading to 60 tons. No permanent settlement was noted.

A. R. Raymer, Assistant Chief Engineer of the R. Hoburgh & Lake Erie Ry., which is building the new line, was in personal charge of the work.

English Pile

A concrete pile somewhat similar to that described above has recently been introduced into engineering practice in Great Britain by Thomas D. Ridley & Son of Middlesbrough, Eng., who hold patents on the construc-



Half-Sections through Concrete Pile Developed by Thomas D. Ridley, Middlesbrough, Eng.

tion. It is described in some detail in *The Engineer* of May 1, 1914. The accompanying figure shows in detail the construction of the pile, the left-half being a section before the entry of the precast pile, and the right-half being a section after the withdrawal of the tube shows the final condition of the pile. In the left-half section a cast concrete pile or column, which has reached a permanent set, has just been lowered onto the top of the semiliquid concrete, which is poured into the previously driven hollow steel tube. For the bulk of its length the precast pile is of considerably less diameter than the tube,

but near its top it is provided with a flange which is an easy fit within the tube. As the pile descends, the liquid concrete displaced by it rises in the tube until it meets the collar, which it finds some difficulty in passing, so that a pressure is set up in the grout. In this way when the tube is withdrawn the concrete is forced into the space up till that time occupied by the tube. Ordinarily the flange would be arranged so that when the pile is in its final position the flange would be just about on ground level.

At the right-hand section of the picture the position of the pile and its flange when the precast pile reaches the bottom of the tube, is shown. It will be noted that the shoe of the tube remains in the position to which it has been driven and forms the foot of the pile. It will also be noted that in soft ground the semiliquid concrete around the precast pile will bulge out into the earth, forming the rough face shown.

While in general use the interior pile will be lowered by gravity and the tube drawn as a separate operation, the Ridley company has perfected and used a device whereby the interior precast pile is forced into the wet concrete and the tube withdrawn by the same operation. This device consists mainly in a toggle which at the same time pushes down on the pile and pulls up on the tube, as a result of the lifting action at the top of the toggle through a line hitched onto the upper sheave of the pile-driver.

These piles have been used in the foundation of a bridge at Seaton Carew, England.

A Combined Pneumatic and Friction Bumper for Terminal Tracks

A new car bumper of the friction type for passenger stations and terminal tracks, has the special feature of a supplementary sliding movement of the bumper upon the rails in the event of the resistance of the buffer piston being overcome.

Bumpers of the piston type have been applied in several large passenger terminals in Europe, and these usually have two cylinders containing oil or other liquid, the cylinders being so spaced that the buffer heads on their piston rods engage with the spring buffers used on European rolling stock. In the new device, there is only one cylinder, its buffer head engaging the coupler head on the car or locomotive. To this buffer head are attached two side rods with plungers bearing against long coiled springs (like the recoil springs of a cannon), which will return the buffer head and piston to normal position when the pressure against the head is removed (by the withdrawal of the locomotive or car which has struck it). The accompanying cut shows the bumper installed on a freight-yard track.

The description in the patent states that the cylinder is to be charged with oil to about 20% of its capacity, but the use of oil is not mentioned in the description sent out by the makers. The force of a light blow will be absorbed by the compression of the air in part of the piston. A heavier blow will drive the piston farther back, forcing the oil out through elongated ports in the bottom, which are so made that the area decreases as the piston advances, thus increasing the retarding effect of the oil. The escaping oil passes through ducts which open into the rear end of the cylinder and relief valves prevent excessive pressure being created. The total stroke is about 3 ft.

For the supplementary sliding movement, the entire supporting base of the bumper is mounted on long channel-shaped shoes fitted upon the heads of rails which are in line with the track rails but depressed below the latter so that the tops of the shoes are level with the tops of the rail heads. These are heavily anchored. The shoes are about 60 ft. long and the depressed rails 100 ft. long, extending about 40 ft. beyond the shoes. At the ends of the shoes are clamps which hold the device in normal position.

When a train approaches the bumper, the forward wheels first run upon the shoes, thus putting a load on the sliding element. Further travel brings the car or engine coupler against the buffer head, driving in the piston. If the first resistance due to compression of the

COMBINED PNEUMATIC AND FRICTION BUMPER FOR TERMINAL TRACKS

air is overcome, and then the resistance due to the compression of the oil, the pressure will cause the entire bumper to slide upon the depressed rails, the friction between the shoes and rails being increased by the weight due to the wheels resting on the shoes. The rails forward of the bumper may be covered by a light platform, so that the space may be used, but the sliding of the bumper would crush through this cover. Ordinarily a travel of 12 ft. will suffice, and only a train at excessive speed would drive the bumper the full available distance of 40 ft., the frictional resistance becoming very high after the first 12 ft.

According to statements furnished by the makers, a 1000-ton train striking the bumper at 3 m.p.h. would be stopped by means of the compression cylinder. At 4 m.p.h. the bumper would be shifted 9 in., and at 8 m.p.h. it would be moved 3 ft., while speeds of 16 and 40 m.p.h. would be required to move it 12 ft. and 40 ft., respectively. This bumper is the invention of W. T. B. MacDonald of Granby, Que., Canada. It is being introduced by the MacDonald Car Buffer Co., of Montreal and Pittsburgh. The President is James Davidson, of Montreal, while the agent for the United States is Joseph L. Neal, 215½ Fourth Ave., Pittsburgh, Penn. The device has been tested experimentally.

Clearance Limits on British railways are much smaller than on American, although the track gage, 4 ft. 8½ in. is the same. A paper by Major Longridge, of the Indian Army, in the "Army Review" for October 1913, states that the maximum clearance limit on English railways is 13 ft. 9 in. in height and 9 ft 8 in. in width at the platform level. Major Longridge states that on American railways the maximum clearances are 16½ ft. in height and 10½ ft. in width.

Laying a 24-in. Cast-Iron Multiple Discharge Sewer Outlet, Vincennes, Ind.

By Robert C. Wheeler*

One of the features of the sanitary sewerage system, of Vincennes, Ind.,† was the dispersion of the sewage in the flowing waters of the river by means of a distributing outlet pipe with multiple-discharge orifices. The details of placing the outlet pipe in the river form the subject of this article.

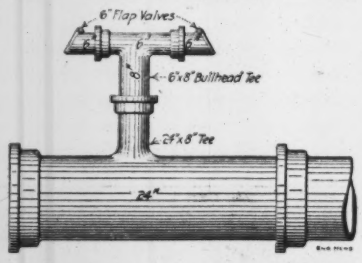


Fig. 1. Special for Multiple Sewer Outlet, Vincennes, Ind.

Description—The 24-in. cast-iron outfall sewer was laid as far into the river as it was possible to pour lead joints with the aid of an earth coffer-dam to keep out the water. Any considerable use of coffer-dams was judged impracticable on account of the extremely porous nature of the river bed. Then a trench was dredged in the river bottom and the remainder of the line was made up on land, towed into position over the trench and lowered into place.

Fig. 3. Ready to launch

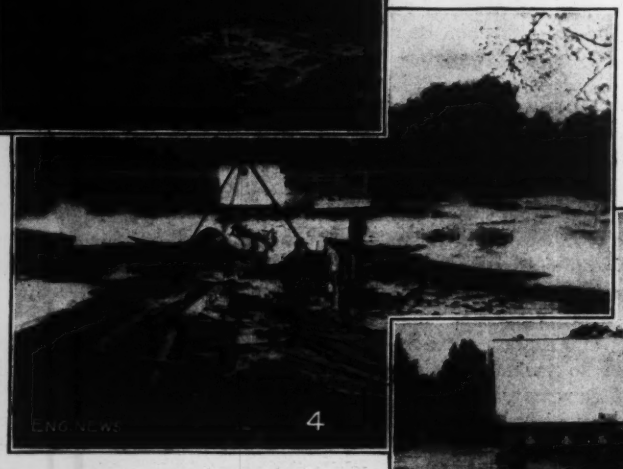


Fig. 4. Partly launched

Composition of Section—The section of pipe line which was to be placed under water was about 180 ft. long and contained, in addition to the 24-in. Class A bell-and-spigot pipe, five double outlets (Figs. 4 and 5) each made up of a 24x8-in. tee, into which was calked an 8x6-in. bullhead tee, having two 8-in. branch spigot and two 6-in. bell outlets. A 6-in. flap valve was leaded into each of the 6-in. outlets. The 24x8-in. tees were spaced about 30 ft. between centers.

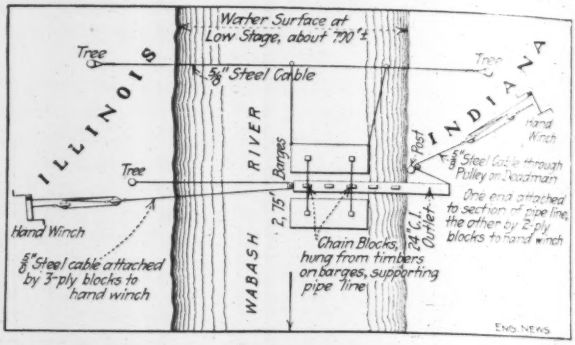


Fig. 2. General Layout of Plant for Placing Submerged 24-In. Cast-Iron Outlet Sewer at Vincennes, Ind.

The total weight of the section was about 43,000 lb.

Excavating the Trench—The outlet pipe was designed to extend from shore nearly at right angles to the direction of current of the river.

The line of excavation was first laid out and a ⅝-in. steel cable was stretched across the river, which at this point is about 700 ft. wide, and anchored so that it hung parallel to the proposed line of excavation and about 200 ft. upstream.

To this cable a gravel boat (hydraulic dredge with gravel pump) was moored and an attempt was made to dredge out the trench.

There had formerly been a ford across the river at this point and the dredge proved ineffective until the surface had been broken. This was accomplished by floating a rooter plow on a

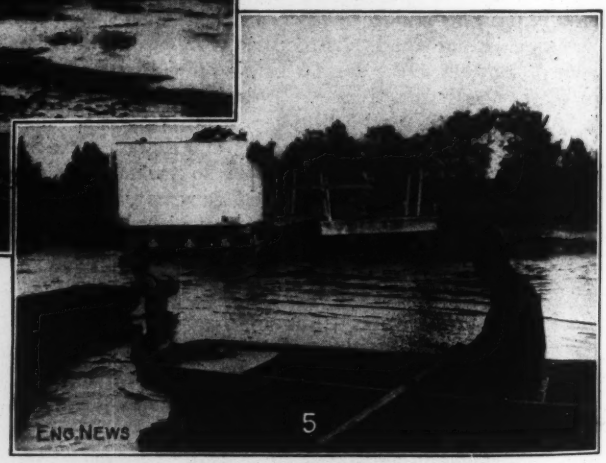


Fig. 5. One of the multiple outlets projecting from the partly submerged pipe

Laying 24-In. Cast-Iron Outlet Sewer, at Vincennes, Ind.

*Resident Engineer for George W. Fuller, 170 Broadway, New York City.

†Described in a paper submitted by the writer to the Indiana Sanitary and Water Supply Association, Feb. 26-27, 1914. The paper was abstracted in "Eng. News," Mar. 5, 1914.

raft to the outer edge of the excavation and pulling it in to the bank through the crust which was formed of gravel and mussel shells. It was possible to do this on account of the extremely low stage of the river and the very gradual slope of the river bed downward toward the west bank, there being a depth of water of only about 3½ ft. at the end of the pipe line.

After the surface had been broken, the trench was easily excavated with the gravel pump. The depth of excavation was regulated so that when the trench had been refilled the flap valves would be about 1½ ft. above the normal river bottom and would be below the surface of the water even at a very low stage of the river.

MAKING UP SECTION ON LAND—The 180-ft. section of the outlet, which was to be placed under water, was laid on a skidway in such a position that it would be necessary to tow it straight out into the river and deposit it in place.

The joints were poured with lead and calked, and the section was fastened together with a cable so that the strain would not come on the lead joints when it was pulled into the river. The cable was so arranged that the pull would come on the first tie in the line and on the inshore end of the line.

DEPOSITING SECTION IN PLACE—The power to move the section was supplied by means of a hand winch on the opposite (Illinois) bank of the river and was transmitted through 3-ply blocks to the free end of a cable which had its other end anchored to a tree and which ran through a pulley at the end of the section of pipe line. A similar arrangement was used on the Indiana side to exert a push on the shore end of the section.

Rollers were put in place under the pipe (Fig. 3) and it was started into the river. As soon as it had been advanced far enough, two 75-ft. barges (Figs. 3, 4, 5) were placed alongside it, one upstream and one downstream, moored from the same cable which had held the dredge. Timbers were laid from one to the other and from these chainblocks were suspended and the weight of the pipe line transferred to the barges. The chainblocks were fastened to the 8-in. branches of the 24x8-in. tees and so held the outlets vertical in addition to supporting the line. The power was again applied and as soon as the section had been moved far enough, a second set of barges and chainblocks were attached to give it the necessary buoyancy and to keep the line from buckling. The line was then moved into place and lowered into the trench which had been dredged for it, leaving a gap of about 10 ft. between it and the line previously laid.

The writer examined the section about 24 hours after it had been placed under water and found that it still contained some air, which would indicate that the joints had not been pulled apart in the operation.

REFILLING TRENCH—When the pipe had been lowered, the barges were moved out of the way, the dredge was brought back and the trench refilled so as to bed the pipe as perfectly as possible.

MULTIPLE OUTLETS NOT IN SERVICE DURING CONSTRUCTION PERIOD—The inshore end of the section was plugged temporarily and the gap between the two sections was left open until shortly before the system was put into operation, when a pipe was cut to fit the opening and concreted in place.

During the construction period, a free outlet into the river was advisable as the ground water was handled through the completed sewer and, since the sewers were bypassed around the pumping station, plank and other material came down which might have clogged the outlets. With the sewer in operation, however, the sewage is screened and undergoes sedimentation which partially clarifies it and removes any material which would readily clog the orifices in the outlet pipe.

The flap valves were arranged so that they opened at right angles to the direction of flow of the river.

The general contractors on the work were Stewart Sheets & Co., and the work was superintended by George W. Fuller, the writer being Resident Engineer.

The Economics of Brick and Other Permanent Road Pavements*

Cost of construction and cost of repair and all else is not the full measure of the economy of a road surface. The greatest element affecting the economy of any road is its out of repair condition. That road which calls for the most frequent repairs is the road that is most likely to be out of repair, and it is the road that in the sum of lapses of time in which it is out of repair, aggregates a total detraction from the road's worth which by the lesser load hauled, the broken spring, the injured horse, the extra wear and tear of the vehicle, if converted into dollars, would often equal in a short period of time, the entire original cost of the road improvement.

When a road is out of repair, the road investment is yielding no return. The road as a whole is only as good as its worst portion, even the rule of averages will not apply. On the other hand, by inverse ratio, the road approaches its maximum worth as repairs are eliminated. The road, therefore, from which repairs are practically eliminated, is the real economic road, provided only that the traffic passing over it meets in a reasonable toll charge, the interest on its cost.

This leads to the proper differentiation as to the choice of the road and the amount of its cost. The expenditure for any road is justified so long as the amount of tonnage passing over it will aggregate a toll equal to a reasonable interest charge on the total investment. To the extent that it exceeds such a sum, it represents a profit to the user.

The original cost of a brick road is not necessarily excessive. The cost of grading, drainage, bridging and the entire preparation for placing the foundation and wearing surface, should be alike for all types and is therefore no more expensive for a brick road than is required for the least expensive type of wearing surface. These preliminary structures are not readily injured, either from wear or tear or from any character of climatic influences. The foundation is likely to remain intact. With the brick wearing surface placed upon it, ample protection for the durability of all the work incident to such preparation is afforded.

*From the paper "The Economy of a Vitrified Brick Road," read by Will P. Blair, Secretary of the National Paving Brick Manufacturers' Association, at the first Canadian and International Good Roads Congress, Montreal, Que., May 18-23, 1914.

Progress on the Arrowrock Dam

By Charles H. Paul*

The highest dam in the world, as the Arrowrock Dam will be when completed to its full height of about 350 ft., had been carried to a height of over 140 ft. above bedrock on Apr. 1, 1914. On that date, all the excavation in the river bed, exceeding 250,000 cu.yd., had been completed; about 36%, or more than 200,000 cu.yd., of the concrete had been placed in the dam, while of the whole work, including the dam, spillway, railroad, power plant and other incidental features, about 50% had been completed.*

The accompanying views, with their explanatory notes, will give a general idea of the character of the work on

*Construction Engineer, Arrowrock Dam, Arrowrock, Idaho.

*For earlier articles on the Arrowrock Dam, see "Engineering News," June 6, 1912; Jan. 16, Mar. 20 and July 17, 1913.

Fig. 1. Portion of Bedrock Foundation

(This view shows the average character of the rock forming the foundation of the dam. It is a hard granite, ideal for foundation, and though somewhat seamy, there are no open, continuous seams. Although this is from 80 to 90 ft. below the present bed of the river, there are evidences that at one time it formed the bottom of the river channel. Some of the rock has been worn very smooth by water action. This photograph is looking downstream, and a little toward the north. The toe of the dam follows approximately a line from the upper right-hand corner of the view to about the middle of the left-hand edge. Cleaning up of the loose material is being done preparatory to washing and scrubbing. This rock is so firm, rough and irregular that it was considered ideal for foundation conditions.)

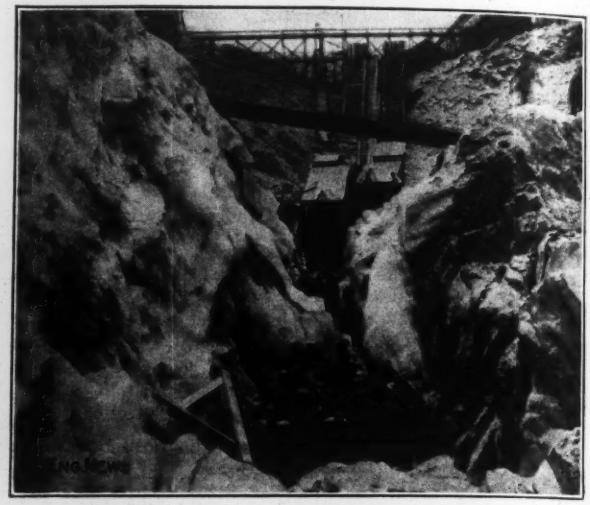


Fig. 2. Gorge in Bedrock Foundation

(This is a deep, narrow, water-worn gorge, the bottom of which is from 20 to 30 ft. below the general level of bedrock. The rock on the left forms a portion of the left abutment of the dam. The view also shows plant used for unwatering the foundation. Each of the two houses inclosed a centrifugal pump and motor, belt connected. These were mounted on trucks, and were moved up and down the inclined tracks by means of hand winches located at the upper end of the slope. There was a flexible connection between each pump and its 15-in. discharge pipe, located between the two tracks. In case of trouble which might cause flooding of the excavation, the pumps could be freed from their discharge pipe by disconnecting one joint, and then pump, motor and suction could be quickly raised up the incline.)

Fig. 3. Dam and Spillway, Looking Downstream, Feb. 20, 1914

(The spillway lip will extend back from the right abutment of the dam to the right-hand limit of the view, a length of 400 ft. The rough excavation for the spillway trench is completed. The tower on the dam is a tail tower for three cableways for placing concrete. Two of the head towers are on the right abutment of the dam. The third cableway goes to the left from the tail tower. The inlet end of the diversion tunnel (capacity 20,000 sec.ft.) may be seen in the lower left-hand corner. About 190,000 cu.yd. of concrete is in place in the dam, or about 35% of its total volume.)

the dam and spillway since the excavation for the dam was completed.

The concrete composing the dam is mixed about 1 part sand-cement, 2½ parts sand, 5½ parts gravel, and 3 parts cobbles, passing a 5½-in. grizzly, but this mix is varied somewhat as conditions may demand, and a richer mix is used for a thickness of from 5 to 10 ft. against each face. Concreting is carried on in two 8-hr. shifts, six days per week, with two 1-yd. mixers. There are three mixer units in the concrete plant, the third being used as an emergency unit.

Up to the end of the season of 1913, all sand and gravel for concrete was obtained from the river-bed excavation. That supply is now exhausted and the material for the remainder of the work is being obtained from a gravel pit along the line of the Arrowrock Railroad, where a steam-shovel outfit and a screening and crushing plant are in operation. From this gravel pit, the sand and gravel are hauled to the mixing plant, a distance of about 14 miles, in standard-gage bottom-dump cars.

In Fig. 4, the concrete mixing plant is at the right. The sand and gravel come in on a standard-gage railroad on the bench. Tracks are extended over the top of storage bins, and bottom-dump cars dump the material directly into the bins.

The sand-cement plant, which furnishes all the cement

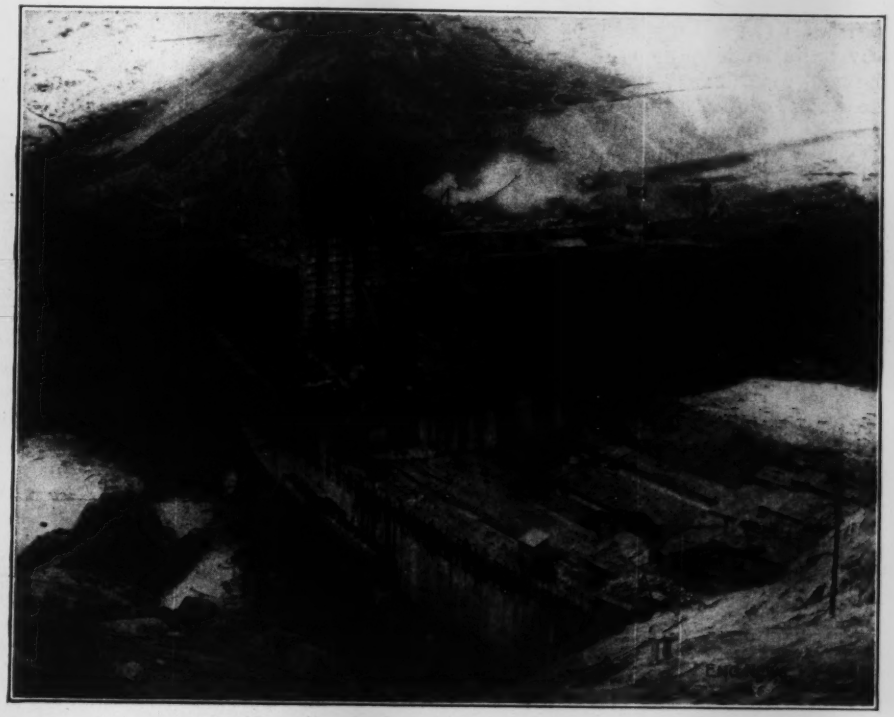


FIG. 4. LOOKING ACROSS THE DAM TO THE SOUTH FROM UPSTREAM SIDE, FEB. 20, 1914

(The trash-rack structure for the five sluicing outlets may be seen on the upstream face of the dam, just at the water surface. The form work for the trash-rack structure for seven of the regulating outlets is in place, just upstream from the stiff-leg derrick on the dam. There will be three more outlets at this elevation just the other side of the tower, which may be used for power development; and about 100 ft. in elevation above these there will be another set of 10 regulating outlets. The concrete mixing plant, with three 1-yd. mixers, is located on the south cliff, just downstream from the dam. The method of distribution of concrete from the cableway is not shown in this photograph, but the cableway bucket discharges automatically into a hopper suspended from the same cableway, at the bottom of which hopper is a chute 40 ft. long, the free end of which may be swung to any position desired within about 40 ft. either side of the cableway. This cableway hopper may be moved to any point along the cableway, but it is held stationary by snub lines while in use. One of these cableway buckets and the hopper without the chute may be seen suspended from one of the cableways at a point just above and to the right of the center of the view.)

FIG. 5. SPILLWAY, LOOKING UPSTREAM

FIG. 6. LOOKING UP THE SPILLWAY TRENCH

(The rough excavation for the spillway trench is completed, ready for trimming and lining. This was a steam-shovel job, and involved the excavation of 256,000 cu.yd. of rock. This spillway trench will be lined with reinforced concrete to a height of 10 or 15 ft. above the water surface, requiring 20,000 to 25,000 cu.yd. of concrete.)

for the work, is located on the opposite side of the river from the mixers, and the cement is transported across the river through lines of 4-in. pipe, by means of compressed air. There are four bins for each mixer, one for cement (in bulk) and the other three for sand, gravel and cobble stones. The cement is weighed out to the mixers, and the other material passes through measuring boxes, the gates for which are operated by air. The concrete from the mixers is dumped into electric, side-dump trolley cars, and is carried from the plant into the base of the tower, where it is discharged into the cableway buckets by means of short chutes passing through the tower to either side. There is a separate track from each mixer to the tower, and the concrete from any mixer may be taken to any one of the three cableways. The cars and the cableway buckets each hold 2 cu.yd. and to facilitate loading without delay, a hopper of 1-cu.yd. capacity is placed below each mixer, so that one batch may be dumped without waiting for the car.

The average unit costs of some of the most important features of the work to date have been:

	Per cu.yd.
Excavation for foundation	$1.07
Spillway excavation	0.65
Concrete in dam	3.73

These figures include superintendence, plant costs (installation and depreciation) and all charges except general overhead charges, which will amount to about 8 to 10%.

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The Construction of Hydraulic-Fill Levees

By D. L. Yarnell*

The proper machinery for the construction of levees to protect lands from periodical overflow has long been a subject of study for engineers, since different conditions require different kinds of equipment. Within the last five or six years, such levees have been built economically by hydraulic dredges, and embankments built by this method have many advantages over those built by other methods. It formerly was considered that hydraulic dredges were not desirable for levee construction for the reason that the large amount of water pumped made it difficult to keep the solid material from spreading over a wider base than needed or desired for the levee. It was generally thought necessary to build ridges forming the toes of the embankment with material dry enough to hold the wet material within the desired limits until the solid matter had been deposited; in this manner one layer was added to another until the desired height for the levee was reached. The need of this dry material is entirely avoided by methods now in use by which the entire section of the levee is built in one operation.

The writer had occasion to examine work done by this method in the Trempealeau Drainage District, on the Mississippi River, near Trempealeau, Wis., and to inspect work in progress in Drainage Districts Nos. 1 and 2 on the Mississippi River in Henderson Co., Ill., and the following notes are based on work there.

Construction Plant

Each of the dredges consisted of a hull 24x80x4½ ft., upon which were mounted a centrifugal pump having one 12-in. suction pipe and a 14-in. discharge pipe, a 200-hp. engine, and a boiler nominally rated at 150 hp. The discharge pipe was carried from the dredge to the top of the levee by small towers mounted on 14x40-ft. barges. The power actually developed by the engine varied with the length of the discharge pipe, the height of delivery and the character of the material pumped.

Building the Embankment and Cost

The views herewith illustrate fully the method of forming the desired slopes by means of steel boards about 18 in. wide and 10 ft. long, of No. 14-gage steel with angle-iron top, not too large or heavy to be easily moved by one man. The slope boards are placed at the intersection of the side slope with the natural slope of the end of the fill under construction. Several men equipped with shovels are necessary to evenly distribute the material and to move the slope boards ahead as the levee is built up.

In the Trempealeau District, there were two separate levees constructed. The levees were built with material from the channel excavated to divert Trempealeau River from near the foothills to Trempealeau Bay. The average width of the levee crown is between 8 and 10 ft., and the average height of embankment is probably 14 ft. The levees have slopes of 1 on 3 on the water side and 1 on 2 on the other, with banquette against the land side upon which is a roadway. The site for the levee was not cleared of vegetation and stumps were not grubbed out for the reason that during the greater part of the construction period, the bed of the levee was flooded. It was assumed that the method of construction so completely sealed the voids around the stumps that moisture enough will be retained and the air excluded to prevent decay. The total earthwork in the two levees and diverting channel is approximately 500,000 cu.yd., which was let at a contract price of 8½c. The construction work was begun in May, 1912, and completed in October of the same year by the LaCrosse Dredging Co., two dredges being used.

Part of the levees in Henderson County, Ill., drainage districts Nos. 1 and 2 are being built by hydraulic dredges. The levee of District No. 2 is a reinforcement placed against the west side of the C., B. & Q. R.R. (Carthage Branch) embankment, carried about 3 ft. higher than the track. The easterly slope of the new fill is 1 on 1½, and the slope on the water side is 1 on 2½. About 126,382 cu.yd. have been let at a contract price of 15.9c., 23,400 yd. at 20c., and there is an additional 5900 yd. for which contract has not yet been let. On the District No. 1, two sections of the levee are to be constructed with a suction dredge. The total length of these two sections is 20,500 ft.; the embankment is to have an 8-ft. crown and 1 on 3 slopes on both sides; the contract price is 11¼c. per cu.yd. The rest of the levee, including probably two to three times the amount of earthwork, with 6-ft. crown, 1 on 3 slope on the water side and 1 on 2 slope on the land side, is to be constructed with a drag-line excavator at 12.1c. per cu.yd. The advertised earthwork, based on a 6-ft. crown throughout the entire length and combined slopes of 1 on 5, was 821,400 cu.yd.

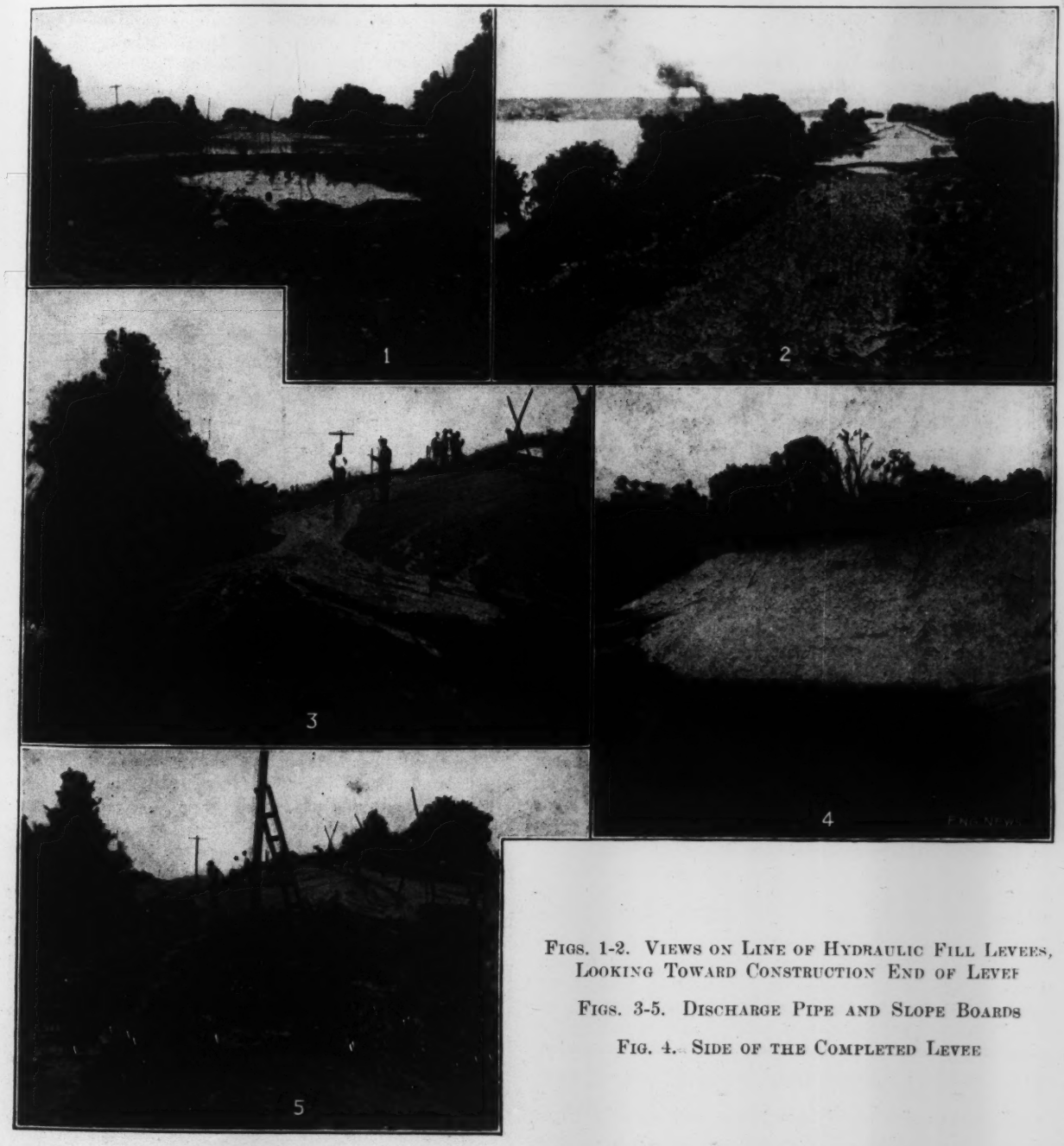
At the time of the inspection, the levee being built was about 14 ft. high, and the top width was 2 to 3 ft. wider than the 8 ft. specified. The designed section of the levee at that point contains practically 26 cu.yd. to the linear foot, and the constructed section about 27 cu.yd. On the

*Drainage Engineer, U. S. Department of Agriculture, Washington, D. C.

day of the inspection, Aug. 23, the two 11-hr. shifts built 100 lin.ft. of completed levee, or 2700 cu.yd. were actually placed. There were no delays for repairs, moving dredge, or any other reason. On this work a strip about 30 ft. wide in the base has been grubbed and ploughed, the entire base being cleared. The number of men usually employed was about 14, and the fuel used about 5 tons of good Illinois coal, in each shift. The average day's work will be considerably less than this, and to the cost of labor and fuel must be added that of delays, repairs, depreciation of plant, preparation of site, superintendence, and overhead charges.

Condition of the Levees

The levees of the Trempealeau District were inspected Aug. 13, 1913, practically a year after the completion of the work, and were found in excellent condition. It must be remembered that these hydraulic-fill levees are built with sand and silt pumped from the bed of the river. In the method of construction used, the silt is always deposited in the base of the levee, the heavier and coarser material being left on top. This means that the top of the levee is built principally of sand while the base is composed of silt. They do not yet have a very



Figs. 1-2. Views on Line of Hydraulic Fill Levees, Looking Toward Construction End of Levee

Figs. 3-5. Discharge Pipe and Slope Boards

Fig. 4. Side of the Completed Levee

Hydraulic-Fill Levees in Henderson County, Ill., Drainage District No. 1.

good covering of sod, principally because the proper kind of grass was not planted. The side slopes have kept their shape will. The levees were tested by high water during the spring of 1913. W. A. Thompson, president of the La Crosse Dredging Co., furnished the following information regarding height of water against the levees: Near Marshland, the water was within a foot of the top of the levee for a few days and no seepage was noticeable. Near Trempealeau Mountain, there was a head of 2 to 4 ft. against the levee and along the railway embankment on the Mississippi River side of 4 to 6 ft. for nearly a month. Two gages referred to the same datum had been set, one at each end of the sluiceway near the mountain; the gage inside the levee did not vary appreciably during that month of the high water, and no seepage was noticeable.

It was also stated that a portion of the South River Levee at Hannibal, Mo., was constructed in the hydraulic-fill method in 1904. That levee has been tested by a number of periods of high water, among others the extremely high water of 1911, and was said to be entirely satisfactory as to withstanding erosion by the current and waves and as to seepage.

Advantages and Disadvantages of Hydraulic-Fill Levees

With hydraulic-fill levees, a wide foreshore can be left. There are no borrow pits to aid in probable seepage and consequent failure of the levee. Any side slope wanted for a levee can be built. There is no shrinkage after the embankment is first completed, for the material is thoroughly compacted. The fine material is deposited in the base of the levee where it is most needed to prevent seepage. By using this hydraulic-fill method a levee can be built across an old bayou or lagoon with as little trouble as on dry ground, which is something few machines can do. Wet, soggy ground gives no trouble in construction. This same principle of building levees is being used at the present time in widening the embankment of the C. B. & Q. R.R., near Glenhaven, Wis.

On the other hand, a 20-ft. head with about 600 to 800 ft. of discharge pipe is the maximum condition under which a plant developing only 200 hp. can operate; greater heights and distances may be overcome by a corresponding increase of power equipment. The dredge must always be in about 8 ft. of water to prevent air from being drawn into the suction pipe. A dredge of this type costs approximately $15,000, not including the discharge pipe, the barges, and other necessary appurtenances, which will add about $5000, making the total first cost about $20,000 for a plant to build levees by this method. It would hardly pay to put such an outfit on a contract of less than 250,000 cu.yd.

A Machine for Winding Continuous Wood-Stave Pipe*

A machine has recently been developed for winding continuous wood-stave pipe with wire in place of using bands as is generally the practice. This device, the invention of H. E. Aine, Pt. Richmond, Calif., is shown in the accompanying figures together with some of the work done with it.

There have been developed two general types of machines under these patents—one is intended for winding a single wire and is largely for use in winding wood lagging or other sectional protection on existing continuous pipe lines of various kinds; the other winds two wires and is intended particularly for continuous wood-stave pipe. Only the latter machine will be described here; the construction for the other obviously is similar.

The machine comprises, first, two semi-cylindrical shells which encircle the staves and are held together with bolts bearing on bolt flanges and having a coiled spring between one flange and the nut. Each of these shells carries a number of semi-circumferential helical hoops pivoted to the shell at their centers and to distance bars at their ends. These are the pitch bars which govern the wire spacing. The bars connecting the pitch hoops have studs which pass through slots in the shells to the outside and which can be adjusted as shown in Fig. 1 to establish any desired pitch.

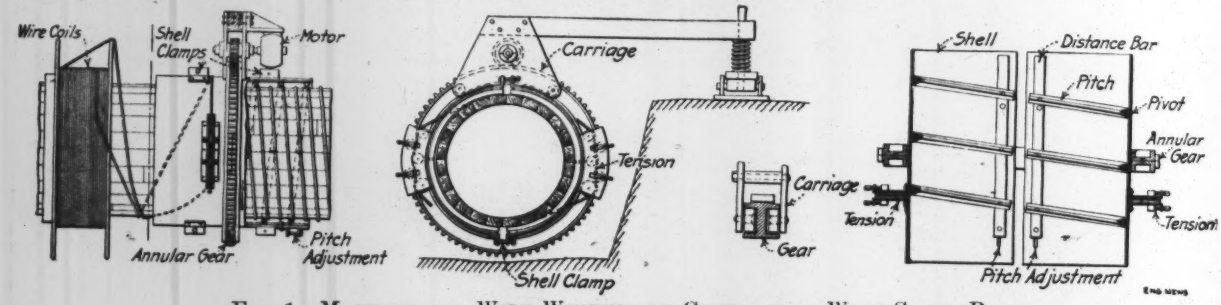


Fig. 1. Machine for Wire Winding of Continuous Wood-Stave Pipe

Each shell carries on its outside a wire-tension device (three fixed and two adjustable rollers in side plates). Surrounding the two shells, as bolted in place around a stave pipe, and secured to them is an annular gear made in two pieces with mortised and bolted ends displaced 90° from the ends of the semicylindrical shells.

The third essential part of the device is a carriage which is supported by rollers running in the side channels of the annular gear and carries a long arm supported at the far end by a small truck or sliding bearing. A motor-driven pinion on the carriage engages with the large gear.

The action of the machine is as follows, staves having been temporarily clamped in place, the machine assembled, and two coils of wire on a reel slipped over the pipe ahead of the machine. The wire ends are led around the pipe once, then through the tension rollers and through openings in the shells to the exterior of the stave pipe. After fastening the ends of the two wires in any suitable fashion, the motor is started—whereupon the gear and shells revolve and the whole machine advances

*From information obtained from Aine and Thompson, Pt. Richmond, Calif.

longitudinally since the pitch bars bite the staves sufficiently to serve as screw threads.

Figs. 2 and 3 show work in progress on an 18-in. (internal diameter) line 2450 ft. long, made up of 1½x4-in. redwood staves wound with two No. 3 A. S. & W. gage galvanized wires on 2-in. center spacing. This line is used to convey fresh water, for condensing purposes, to an oil refinery. The head at present is small, but will be increased. A similar but smaller line has also been installed and both are reported to be giving satisfaction.

The staves were assembled over light spring forms, which were drawn ahead as the temporary clamps were adjusted. Coils of wire were slipped over the pipe at intervals depending on their weight and length. The wire ends of the two coils were electrically welded, a portable 2½-hp. gasoline engine generator set being used. The winding-machine motor was run by compressed air. Only some 8 to 10 in. was required in the ditch on either side of the pipe.

On this job there were employed one superintendent (at $5 per day); one electrician ($4); one operator ($3) and two helpers ($2.50) for the winding machine and wire reel; one laborer ($2) for machine lever; one carpenter ($4); one helper ($2) and two laborers ($2) for assembling staves. The total labor cost was $29.50 per day. An average of 420 ft. per day was laid. With a more experienced crew it is expected that 600 ft. could be laid.

The pipe was painted with a heavy coat of asphalt before being dropped from its blocking to the ground. On turning on the water, several leaks showed up owing to shrinkage of staves in the hot water. These seams gradually closed up and in 24 hr. the pipe was tight.

We are indebted to Mr. Aine for the information and views herewith.

FIG. 2. WIRE-WINDING MACHINE WORKING ON 18-IN. PIPE IN SHALLOW DITCH

FIG. 3. WIRE-WINDING MACHINE WORKING UNDER CROSS PIPE

An Open Letter to Jas. W. Osborne

We published in our issue of March 25, the report on New York State highway work made to Gov. Glynn by the special investigator appointed by the Governor, Jas. W. Osborne. In that report a reference was made to the work of the State Highway Commission appointed by Gov. Hughes.

Following the above publication we received from one of the members of that Commission a copy of a letter to Mr. Osborne with a request for publication. After holding the letter for several weeks awaiting a reply by Mr. Osborne, we publish the letter below in fairness to Mr. Allen and his associates on the New York Highway Commission appointed by Gov. Hughes.

Hon. Jas. W. Osborne:

Sir—I note in ENGINEERING NEWS, of Mar. 25, 1914, an extract from a report made by you to Governor Glynn, in which is the following statement:

> I find that in many instances where the specifications have failed to be of advantage to the contractors, they have been changed or modified without public letting, so as to make the contract pay. This practice amounts to a total annihilation of the law regarding advertisements for bids, as the revised contract is practically a new contract. I find this evil existed under the commission appointed by Governor Hughes, consisting of S. Percy Hooker, Robert Earl and T. Warren Allen. . . .

I respectfully request that you give me a list of the contracts upon which you base the above assertion and the reasons in each case for the making of such assertion. I note in particular your statement that the changes were made "so as to make the contract pay." I am anxious to find out where changes were made in specifications for this purpose. I am asking ENGINEERING NEWS to publish this letter.

T. WARREN ALLEN.

Water Terminals on the Mississippi River

The movement for the development of inland navigation has been directed mainly to the improvement of the waterways themselves. We have pointed out at different times that terminal facilities as convenient as those of railway terminals must be provided if water transport is to compete with rail transport.

This matter has now been taken up by a waterway organization, and the question of terminal facilities along the Mississippi River is to be investigated, with a view to providing adequate facilities for the efficient and economical accommodation of vessels and handling of freight.

A conference on the river terminal question was held Apr. 28 in the office of the Business Men's League, of St. Louis, and was attended by Governor Eberhart (Minnesota), Governor Dunne (Illinois), Governor Major (Missouri), and about 20 representatives of commercial organizations from Minneapolis to New Orleans. The meeting was for the purpose of forming some plan to provide for a uniform system of river terminals, and resulted in the appointment of Governors Eberhardt, Dunne and Major as a special committee to devise plans for a permanent organization to be perfected in St. Louis some time next fall. It is thought probable that some form of recommendation will be made to the governors of the various states in the Mississippi valley for a plan of getting each state to bear its share in the expense of employing engineers to work out the best possible terminal system for all the cities in the Mississippi Valley.

Mr. Ockerson, of the Mississippi River Commission, presented a resolution, which was adopted, to the effect that "adequate terminals for the interchange of freight between river and rail are essential to the restoration of traffic on the Mississippi River and its tributaries." Governor Eberhart referred to the necessity of engineering assistance in such work and stated that Minnesota had already selected an engineer to report on the matter. He urged that the state authorities should take action and assume some of the financial responsibility, instead of leaving this entirely to private capital. Governor Dunne said it was very important that when cities have established their water-front terminals and facilities they should retain control of them and not permit them to come under private control.

From the various speeches made it appears that Kansas City voted $75,000 in bonds for the improvement of its municipal wharf. This wharf is now 566 ft. long, having 350 ft. covered with a reinforced-concrete shed; it has also machinery equipment and railway connections. The city of Minneapolis will secure 1680 ft. of water front and provide sheds and warehouses for a municipal harbor above the new U. S. Government lock and dam. At Keokuk, the first appropriation has been made for a project involving a river-front wharf 1900 ft. long. At Alton, the city owns the water front and has an incline track for transferring freight from barges to cars. The situation at Davenport was described as follows by A. M. Compton:

The city of Davenport has approximately 3500 ft. of improved water front, of which 1600 ft. has been laid aside for public park purposes. There is 1400 ft. completed of modern water terminals, equipped with such apparatus, cranes and railway tracks, belt lines, operated by the city government, as will permit us to handle this summer 50,000 tons a month.

About ten years ago we secured from the legislature a law under which is formed what we call the Levee Improvement Commission. It applies to every city in Iowa on the Mississippi, but at that time applied strictly to Davenport. The commission is composed of five business men, who serve without compensation. They have absolute charge of the river front from the first main business street out to the pierhead line established by the Government. They obtained all their money from bond issues, at about 4%. From the land reclaimed at the expiration of our work we will have an income of approximately $25,000 per year from the terminals and from the railroads which connect with our belt lines.

We have spent less than $100,000. That $25,000 income will finance practically $400,000 worth of work. We have $1,000,000 in sight to spend on more than 2½ miles of river front. This will all be done without increasing the tax rate a single mill. The terminals will be self-supporting, and the same thing can be done in other cities and towns.

Classification of Pavements and Bidding Form, Department of Public Improvements, Omaha, Neb.

Below is given the rather elaborate classification of pavements adopted by the Department of Public Improvements of the City of Omaha, Neb. This classification is necessary to the bidding form shown in the accompanying illustration. This scheme was adopted in February, 1914, and all the pavement work is now done under contracts and specifications based on these classifications.

CURBING

STONE, Class (1), 5 in. thick, 24 in. deep. Class (2), 5 in. thick, 20 in. deep.

ARTIFICIAL STONE, Class (1), 7 in. thick, 24 in. deep. Class (2), 7 in. thick, 20 in. deep. Class (3), steel-bound curb, 7 in. thick, 20 in. deep.

ARTIFICIAL STONE COMBINED CURB AND GUTTER, Class (A), 16 in. gutter.

PAVING

ASPHALT, Class (A), concrete 6 in., asphaltic-concrete binder, 1½ in., wearing surface of asphaltic mixture 2 in. Class (B), concrete 5 in., asphaltic-concrete binder 1½ in.; wearing surface of asphaltic mixture, 1½ in. Class (C), for repaving old concrete base. Sufficient concrete to raise the pavement to the required grade asphaltic-concrete binder 1½ in.; wearing surface of asphaltic mixture, 2 in. Class (D), for repaving over old concrete base. Sufficient concrete to raise the pavement to the required grade; asphaltic-concrete binder 1½ in.; wearing surface of asphaltic mixture, 1½ in.

ASPHALTIC CONCRETE, Class (A), concrete 5 in.; asphaltic-concrete wearing surface, 2 in. Class (B), for repaving only. Sufficient concrete to raise the pavement to the required grade; asphaltic-concrete wearing surface, 2 in.

STONE, Class (A), concrete 6 in.; sand cushion 2 in.; granite blocks of standard size. Portland-cement grout filler. Class (B), concrete 5 in.; sand cushion 2 in.; granite blocks of standard size. Portland-cement grout filler. Class (C), for repaving only. Sufficient concrete to raise the pavement to the required grade. Sand cushion 2 in.; granite blocks of standard size. Portland-cement grout filler. Class (D), concrete 6 in.; sand cushion 2 in.; sandstone blocks of standard size. Portland-cement grout filler. Class (E), concrete 5 in.; sand cushion 2 in.; sandstone blocks of standard size. Portland-cement grout filler. Class (F), for repaving only. Sufficient concrete to raise the pavement to the required grade; sand cushion 2 in.; sandstone blocks of standard size. Portland cement grout filler.

VITRIFIED BRICK, Class (A), concrete 6 in.; sand cushion 1½ in.; vitrified brick of standard size. Bituminous filled joints. Class (B), concrete 5 in.; sand cushion 1½ in.; vitrified brick of standard size. Bituminous filled joints. Class (C), for repaving only. Sufficient concrete to raise the pavement to the required grade; sand cushion 1½ in.; vitrified brick of standard size. Bituminous filled joints.

VITRIFIED BRICK BLOCK, Class (A), concrete 6 in.; sand cushion 1½ in.; vitrified brick block of standard size. Bituminous filled joints. Class (B), concrete 5 in.; sand cushion 1½ in.; vitrified brick block of standard size. Bituminous

filled joints. Class (C), for repaving only. Sufficient concrete to raise the pavement to the required grade; sand cushion 1½ in.; vitrified brick blocks of standard size. Bituminous filled joints.

VERTICAL FIBER BRICK, Class (A), concrete 5 in.; sand cushion 1½ in.; vertical fiber brick as specified, 3 in. Bituminous filled joints. Class (B), concrete 5 in.; sand cushion 1½ in.; vertical fiber brick as specified 2½ in. Bituminous filled joints. Class (C), for repaving only. Sufficient concrete to raise the pavement to the required grade; sand cushion, 1½ in.; vertical fiber brick as specified, 3 in. Bituminous filler. Class (D), for repaving only. Sufficient concrete to raise the pavement to the required grade; sand cushion 1½ in.; vertical fiber brick as specified, 2½ in. Bituminous filler.

parable with the other proposals. Below is the form of proposal, accompanying the bidding blank, or "Schedule of Prices."

PROPOSAL

Omaha, Nebraska.....

To the Honorable City Council of the City of Omaha:

It is hereby proposed by the undersigned to.....

.....

from..... to.....

within Street Improvement District No.....by furnishing all the material and labor for making the necessary excavations for such improvement and constructing the necessary foundations and improving said district, including any and all work and materials that may be necessary to connect the work done with the adjoining work in a proper and workmanlike manner; said improvement to be done in accordance

SCHEDULE OF PRICES

—7—8—

PAVING

Price Per Square Yard

CLASS	ASPHALT Guarantee 5 Yrs.		ASP. CONC. Guarantee 5 Yrs.		STONE Guarantee 1 Yr.		VIT. BRICK Guarantee 1 Yr.		VIT. BR. BLK. Guarantee 1 Yr.		VER. FIBER BR. Guarantee 1 Yr.		CRE. WD. BLK. Guarantee 5 Yrs.		ART. STONE Guarantee 5 Yrs.		MACADAM Guarantee 5 Yrs.		Guarantee ....Yrs.	
A																				
B																				
C																				
D																				
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F																				

CURBING

Price per Foot to Include Curved, Straight, Combined Curb and Gutter or Regular Curb as Laid

NATURAL STONE Guarantee 1 Year	PRICE PER LINEAL FOOT CLASS 1		CLASS 2	
.....Stone				
.....Stone				
.....Stone				
.....Stone				
Curved Section for Private Drive ..... Price not to Exceed $1.00				

ARTIFICIAL STONE Guarantee 5 Years	PER LIN. FOOT	
Curb-Class 1		
Curb -Class 2		
Combined Curb and Gutter		
Curved Section for Private Drive Price not to Exceed $1.00		

SUNDRIES

	BIDS IN FIGURES		BIDS NOT TO EXCEED	
Concrete, per cubic yard			$5	00
Gravel, per cubic yard.			2	50
Broken Stone, per cubic yard			2	50
Sand, per cubic yard			1	50
Resetting old Curb, per lin. ft.				15
Re-cutting old Curb, per lin. ft.				15
4-in. Drain Tile, per lin. ft. [laid]				
Headers, per lin. foot.				25
Grading, per cubic yard				40

The Commercial Designation of the Materials to be used if this Proposal is Accepted and the Contract Awarded to the Undersigned is:

MATERIAL	COMMERCIAL DESIGNATION	SOURCE

The Undersigned further Agrees to Complete the Work within the Time Designated upon the Plans.

Names of parties interested with the undersigned in this proposal.

.....

.....

.....

Signature of Bidder.

.....

.....

.....

N B.—By the source is meant the locality, quarry, kiln or factory from which will be obtained the specific materials proposed to be used.

FORM FOR MAKING PROPOSALS ON STREET IMPROVEMENT WORK, OMAHA, NEB.

CREOSOTED-WOOD BLOCK, Class (A), concrete 6 in.; sand cushion 1 in.; creosoted-wood blocks as specified, 3½ in. Class (B), concrete 6 in.; sand cushion 1 in.; creosoted-wood blocks as specified 3 in. Class (C), concrete 5 in.; sand cushion 1 in.; creosoted-wood blocks as specified, 3½ in. Class (D), concrete 5 in.; sand cushion 1 in.; creosoted-wood blocks as specified, 3 in. Class (E), for repaving only. Sufficient concrete to raise the pavement to the required grade; sand cushion 1 in.; creosoted-wood blocks as specified, 3½ in. Class (F), for repaving only. Sufficient concrete to raise the pavement to the required grade; sand cushion 1 in.; creosoted-wood blocks as specified, 3 in.

ARTIFICIAL STONE Class (A), portland-cement concrete 6 in. in depth. Class (B), for repaving only. Sufficient concrete to raise pavement to required grade; in no case to be less than 4 in.

MACADAM, Class (A), for original paving. Uniform depth of 7½ in., with bituminous filler of 1½ gal. per square yard. Class (B), for repaving over old base. Wearing surface of 3½ in. crushed granite or quartzite with bituminous filler of 1½ gal. per square yard.

The proposal is very simple in form and easily comwith the plans prepared by, and on file in the Office of, the City Engineer; upon the terms and conditions of the specifications, stipulations and form of contract and bond herein; and in conformity with the rules and regulations of the City. It is also agreed that said work shall be done under the direction and supervision of the City Engineer, subject to his acceptance and the approval thereof by the City Council of the City of Omaha, at the prices shown in the accompanying "Schedule of Prices." which shall form the basis of the proposal on the improvement herein specified.

GUARANTEES—Curbing and paving constructed under the specifications accompanying this proposal must be maintained in good condition by the contractor, satisfactory to the city engineer, for these periods:

Curbing—Natural stone, 1 year; artificial stone, 5 years; artificial stone, combined curb and gutter, 5 years.

Pavements—Asphalt, 5 years; asphaltic concrete, 5 years; stone, 1 year; vitrified brick, 1 year; vitrified brick block, 1 year; vertical fiber brick, 1 year; creosoted-wood block, 5 years; artificial stone, 5 years; macadam, 5 years.

Demolition of Old Trainshed, Union Passenger Depot, Cleveland, Ohio

After 49 years of service the 180x600-ft. trainshed of the Union Passenger Depot at Cleveland is being taken down, while the business of the station continues uninterrupted. A new Union Station is to be built, but on another site; the demolition of the old roof is going on, not to make room for the new station, but because the roof was superannuated and unsafe; its safety has been under suspicion for some years.

Carrying out such demolition work without inconvenience or danger to the passenger traffic below, is necessarily difficult and delicate. Well devised plant and methods are handling the work with great success. The Lake Shore & Michigan Southern Ry. is doing the work direct, under B. R. Leffler, Bridge Engineer of the railway.

one bay just over the traveler, immediately before the dismembering and removal of the rear truss of that bay.

Demolition Traveler

The drawing (Fig. 1) shows the traveler in elevation; the roof truss is indicated by heavy broken lines. The main structure of the traveler is a Pratt-truss bridge of combination wood-and-steel construction, supported above railway clearance by timber legs (longitudinal bents) knee-braced to the bridge. On this bridge is supported a superstructure shaped to the underside of the arch rib or top chord of the roof truss. A section through the traveler is also given in Fig. 1, and here are shown four platforms bracketed out from its front face. The upper one of these platforms (or rather the curved upper deck of the traveler) has an overhang of about 14 ft. The lower platform comes just below the roof tie-bars; the upper three overhanging platforms, which cross the

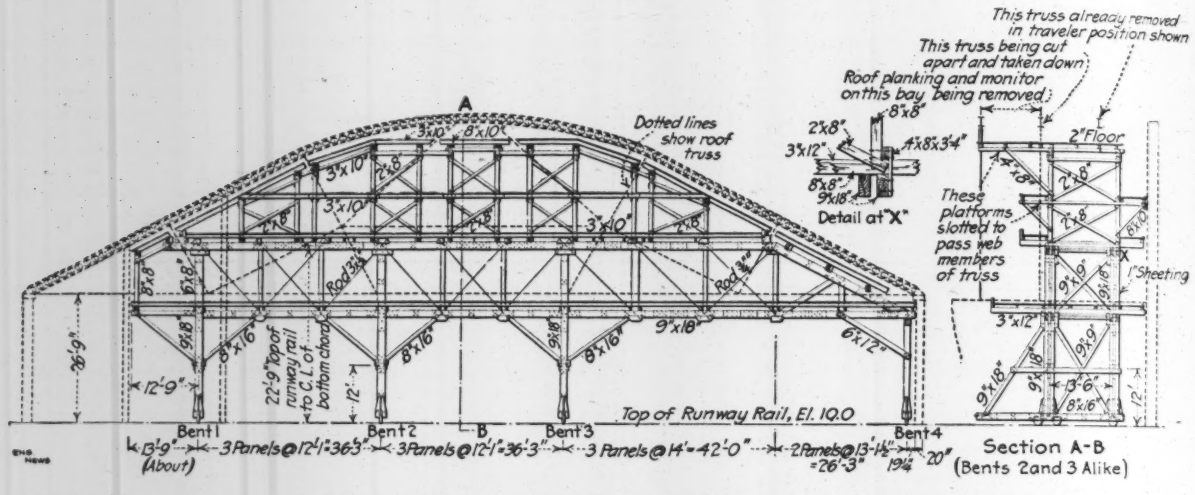
This truss already removed in traveler position shown
This truss being cut apart and taken down
Roof planking and monitor on this bay being removed
Dotted lines show roof truss
Detail at "X"
These platforms slotted to pass web members of truss
2"Floor
1"Sheeting
Top of Runway Rail, El. 100
Bent 1
Bent 2
B
Bent 3
Bent 4
3 Panels @ 12'-1"=36'-3"
3 Panels @ 14'-42'-0"
2 Panels @ 13'-1½"=26'-3"
Section A-B
(Bents 2 and 3 Alike)

Fig. 1. Elevation and Section of Traveler for Trainshed Demolition, Union Station, Cleveland.
(Note that slotting of cantilever platforms admits the web-members of the truss being taken down. This truss is wedged up on the traveler deck and cut into sections by oxyacetylene flame.)

The roof trusses, seated on stone side-walls about 27 ft. high, are very closely spaced—about 12 ft.—and are of peculiar indeterminate type, as will be illustrated in a later issue. They may be called rib arches with bottom-chord tie, but they have also a web system composed mainly of thin tension members. This web system would interfere with the use of a traveling falsework structure or centering such as was employed in taking down the old arch-roof trainshed of the Grand Central Terminal, New York City, some four years ago. By an ingenious modification in design, however, a centering traveler was constructed which could pass through the web of a roof truss and support an entire bay of the roof, while removing it.

A controlling feature of the work was the fact that the roof, being old and of indeterminate character, could not safely bear any additional loading, whether of staging or of material, and that (for the same reason) no part of the roof could be weakened by removal of some members before it was fully supported from below. Further, the roof planking was built into the structure of the roof, and probably acted as the principal bracing. Therefore, no part of the roof was stripped or removed except in the web system of the roof trusses, are *slotted in line of the various web members,* all the way back to the main body of the traveler. This expedient makes it possible to push the traveler forward *through* the web system of a roof-truss, for enough so that the upper deck extends under one entire bay of the roof and shelters the space below against falling material.

Working Procedure

The manner of working is easily explained in its general outlines, in connection with Fig. 1. When the traveler is first set to the position shown by the sectional view, the two forward roof trusses, i.e., those over the overhang of the deck, are complete and undisturbed, as is also the slate and roof-planking in the bay between them. All roof and trusses back of them, however, have already been removed. The work to be done in this setting of the traveler is the removal of one truss and one bay of slate and planking.

The first step is to block up the rear truss on the deck of the traveler by blocks and wedges. As the section shows, the truss comes practically over the front frame of the traveler, so that it puts but little load on the over-

FIG. 2. OUTSIDE VIEW OF DEMOLITION WORK, CLEVELAND UNION PASSENGER DEPOT

hanging platform. As soon as this blocking-up is done, one gang of men starts to tear off the roofing, and another gang starts cutting apart the arch rib of the rear truss. The slate, roofing boards, etc., are skidded down the slope of the traveler deck and lowered away, as fast as torn off. The top chord or arch rib of the truss is cut across at numerous points by oxyacetylene flame—upper and lower flange bars and two side bars, each about 6x⅝-in. wrought iron; the connecting bolts and cast-iron spiders of the rib at the point of cutting are easily knocked out. There are also some longitudinal angle-iron struts from truss to truss (and at a few points diagonal braces), which are similarly burned off. This completed, the sections of arch rib can be slacked down on their blocking and the attached web members disconnected.

All the tension rods of the web are attached in very simple manner, as by looping over a cross-bar laid over the arch rib. The only two struts in the web system (one each side) are butted against the rib and tie-bar, and come out easily when the main members are disconnected. The lower overhanging platforms are at such levels that they come just under the main tie-bar and the auxiliary tie-bar or intermediate chord; these members and the web system are therefore easily handled as soon as the rib is cut apart and slacked off.

When the truss is completely taken down and the pieces lowered to the ground at one side (the north or free side of the trainshed), the traveler is ready for moving forward. For this, a thrust-beam and an ordinary track jack are set behind each bent of the traveler, about as sketched in Fig. 7.

The thrust-beam is held to the rail of the traveler track by a simplhe cramp formed of a V-stirrup held at the bottom by a bolt through a hole in the rail web. Before the work started it was thought that the stirrup

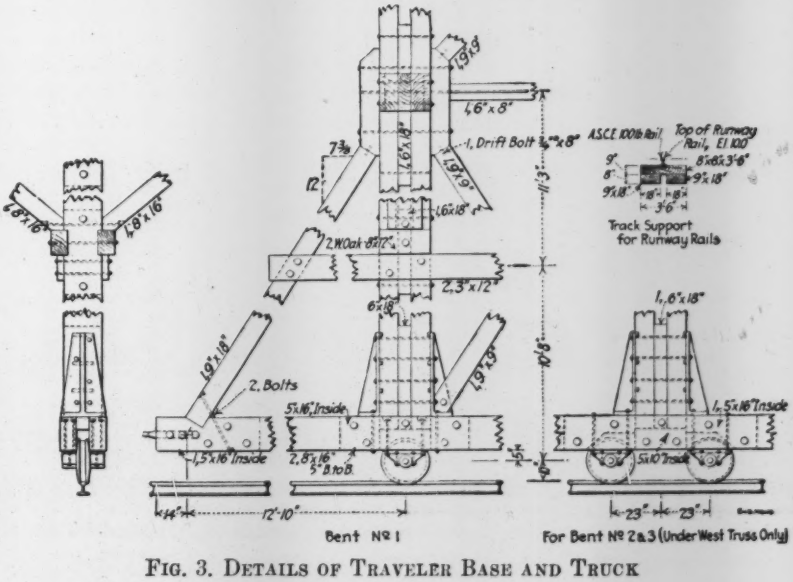

FIG. 3. DETAILS OF TRAVELER BASE AND TRUCK

FIG. 4. TAKING DOWN EAST WALL, OLD UNION PASSENGER DEPOT, CLEVELAND, OHIO

(Traveler built inside trainshed, several bays of roof taken down, and removal of wall begun.)

FIG. 5. CUTTING APART THE ARCH RIB OR TOP CHORD OF A ROOF TRUSS BY OXYACETYLENE TORCH, CLEVELAND UNION PASSENGER DEPOT

(Flange and side plates are wrought iron; web spiders are cast iron; assembly bolts are wrought iron.)

needed positive engagement with the beam, and notches were cut in the top of the beam for this purpose. In use, however, it was found that the stirrup binds tight on the flat of the beam, and the notched face of the thrust-beam is usually turned down, as sketched.

The traveler weighs 200 tons complete, and when moving puts considerably more than 50 tons maximum load on the supports of a bent. There has been no difficulty moving it, however, and two men at each of the jacks advance it without delay. A complete move of one bay (12 ft.) takes only about 25 min. In fact, sometimes the blocking under the ends of the sills is not even knocked out, and the motion is part rolling and part sliding (on greased rail).

The construction of the traveler track is indicated by a small sketch in Fig. 3. A trench about 18 in. deep is dug on the line of each rail, ahead of the traveler, and a pair of stringers laid down; short ties on the stringers carry a 100-lb. rail. The sections of track back of the traveler are moved forward as released, so that only a small amount of track material is used.

SPECIAL FEATURES OF THE WORK

Work was begun on the east end of the trainshed. The gable wall had to be taken down as the first operation. For this, the traveler was built just inward of the wall, the rear overhanging platforms practically touching the wall. Two bays of roof were then taken down, in the manner already described except that the traveler was not moved. This gave room for setting up the six small stiff-leg derricks (see Figs. 4, 6) on top of the traveler, at its rear edge, for handling the wall stones.

Stone was lowered onto the lower rear platform, into carry cars running on the platform to the north side of

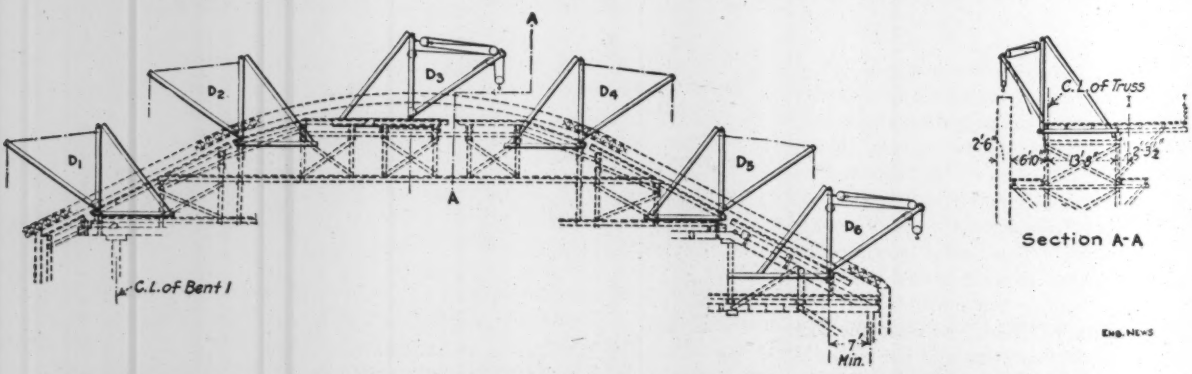

FIG. 6. SKETCH SHOWING POSITION OF DERRICKS, UNION STATION TRAINSHED DEMOLITION, CLEVELAND

(The chief use of the derricks is removing the end walls. In taking down the roof itself, the north derrick is mainly used, material being slid or lowered down to it along the traveler decking.)

the trainshed, whence they were rehandled into cars alongside. Six days work was required for the demolition of the wall. After this, the traveler moved forward in successive 12-ft. stages and took down the roof trusses as described. In handling the roof material the derricks are little used, except that at the north end.

In the easterly half of the trainshed, a longitudinal brick wall extending to the roof cut off a narrow room along the south or street side. This wall, and the roof over the room, were left undisturbed, the arch ribs being cut off close to the wall. As Fig. 1 shows, the traveler is unsymmetrical, extending south only to this wall.

In the west half of the trainshed, however, there is a brick partition wall some 20 ft. farther in, forming the waiting-rooms and other main spaces of the station. When this section was reached, the traveler had to be shortened in width, by removing the south bent and some of the framing, leaving its ends to cantilever over the next bent. But instead of cutting the roof at the waiting-room wall, it is cut on the same line as in the easterly part (i.e., over the more southerly partition), and a ridge formed on this line by building a new roof sloping down

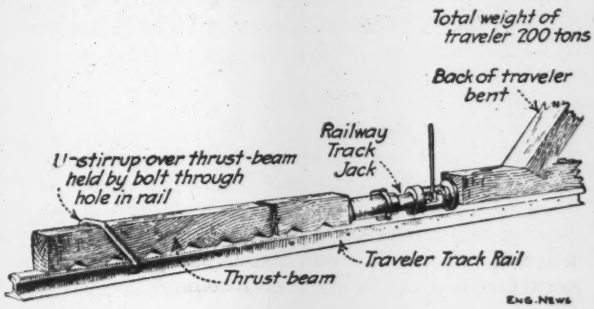
Total weight of traveler 200 tons
Back of traveler bent
Railway Track Jack
U-stirrup over thrust-beam held by bolt through hole in rail
Traveler Track Rail
Thrust-beam
ENG. NEWS

FIG. 7. ARRANGEMENT FOR JACKING TRAVELER FORWARD

northerly to the waiting-room partition, with timber supports as required. The waiting-room partition is removed down to the new eave line, the work being done some distance ahead of the traveler.

In taking down this partition, it was found that the arch ribs had a slight degree of bearing on the partition wall, the brickwork being built close up against the ribs. Although the roof doubtless was designed for the full span, when the brickwork was all removed from under the ribs the roof deflected at this point by ¼ to ⅜ in. on the average.

The demolition has been progressing very rapidly. Not counting the time required for erecting the traveler, or the time occupied by removal of the east wall, an average rate of working of 1½ bays per day was maintained in the easterly half. The westerly half may average rather slower progress, a rate of one bay per day is counted on. The work is now practically completed.

After renewal of the old shed, the station tracks will be rearranged, one running track added, additional crossovers built, and butterfly sheds constructed over the platforms, as temporary provision until the new station is ready, some years hence.

The designer of the trainshed, B. F. Morse, died about two months ago. The train carrying his body passed through the Union Station on the very day when demolition work started.

Engineering Work at Chicago during 1914

The engineering work in and around a large city like Chicago is of a varied character and represents in the aggregate an enormous expenditure. We give below a review of some of the work now under way or contemplated for the present year, as compiled from information furnished us for this purpose.

WATER-WORKS

The water-works construction contemplated for this year, with the estimated expenditures on the work during the year, is summarized below from a statement furnished by Mr. Ericson, City Engineer:

Roseland pumping station, $256,000 (out of a total estimated cost of $270,000); booster pumps, $38,000.

Lake View pumping station, $616,816; new breakwater, $25,000.

Wilson Ave. tunnel and crib, $900,000 (estimated cost $5,465,000). The shore shaft for the lake section has been sunk, and plans are being prepared for the land section.

35th St. tunnel and crib; $50,000 (estimated cost $4,750,000).

Central Park Ave. pumping station, $8000; new centrifugal pump, $10,000 (estimated cost $45,000).

Springfield Ave. pumping station, $8000; centrifugal pump, $5735 (estimated cost $45,000).

14th St. pumping station; centrifugal pump, $41,165 (estimated cost $46,000); new crane, etc., $4195 ($22,000); lowering suction pipe, wiring, etc., $10,000 ($20,000).

Harrison St. pumping station, $36,300 (estimated cost $71,000).

22nd St. pumping station, $50,000; wiring, etc., $3000.

68th St. pumping station; installing two centrifugal pumps, $15,000.

Fullerton Ave. pumping station, $5000.

Chicago Ave. pumping station; two 25,000,000-gal. engines, $5000 (estimated cost, $250,000); changes to buildings, $30,000 ($525,000); changes to tunnels, $35,000; new boiler plant and coal-handling plant, $35,000 ($200,000 total).

Chicago Ave. water tower, $5000.

Mayfair pumping station, $100,000 (estimated cost $1,375,000).

Marshall Blvd. plant, $317,542 ($469,000); equipment, $60,000 ($220,000).

31st St. pumping station (stock yards), $250,000 (estimated cost, $1,250,000.

Jefferson Park pumping station, $1635.

Garage and equipment, $12,000.

Laying large water pipe, meter connections, feeder mains, etc., $1,160,000.

BRIDGES

The extensive bridge work contemplated is summarized in the accompanying table, also from information furnished by Mr. Ericson. In addition to this, there will be the work of the Sanitary District on the substructure and superstructure of the new Jackson Boulevard bridge, which will cost about $375,000.

BRIDGE WORK IN CHICAGO, 1914

Bridge	Date of Bids	Estimated cost	To be expended in 1914	Date of completion
12th St.*	.....	$600,000	.....	.....
Lake St.	Feb. 1, 1914	580,000	$250,000	Mar. 1, 1916
Madison St.	Feb. 10, 1914	400,000	225,000	Nov. 15, 1915
Clark St.	Sept. 1, 1914	400,000	50,000	Oct. 1, 1916
Webster Ave.	Mar. 1, 1914	300,000	200,000	Oct. 1, 1916
Belmont Ave.	Apr. 1, 1914	300,000	200,000	Nov. 1, 1915
106th St.	Dec. 20, 1914	300,000	5,000	Sept. 20, 1916
Weed St.	Aug. 1, 1914	175,000	60,000	Dec. 1, 1915
Fuller St.	Oct. 1, 1914	175,000	40,000	May 1, 1916
So. Calif. Ave.†	May 1, 1914	125,000	80,000	June 1, 1915
So. Calif. Ave.‡	May 1, 1914	30,000	30,000	Nov. 1, 1914
Montrose Ave.	May 1, 1914	70,000	70,000	Oct. 1, 1914
Torrence Ave.	Mar. 1, 1914	22,000	22,000	June 15, 1914
Total	.....	$3,477,000	$1,232,000	

Sewers

We are informed by C. D. Hill, Chief Engineer of the Board of Local Improvements, that during 1914 the Board will do the usual amount of sewer construction. It will complete the contract for the Albany Ave. system of sewers (John W. Farley, contractor), at a total cost of about $40,000. It is expected to confirm the assessment and let the contract for a similar system of sewers in Rockwell St. and other streets from the west fork of the South Branch of the Chicago River extending north to about Monroe St. The total cost of this system of sewers will be about $350,000.

It is probable that the assessment will be confirmed and contract started on the Norwood Park system of sewers, which will drain all the territory within the city limits lying north of Lawrence Ave. and west and southwest of the North Branch of the Chicago River. It will cost approximately $700,000. Studies are being made and preliminary plans drawn for two or three large relief sewers, one of which will run through the stockyards and along the line of Center Ave., and will drain about 6 sq.mi. south of 39th St. that is sewered at the present time in an inadequate manner. Plans are being prepared for a similar sewer in Augusta St., extending from the North Branch of the Chicago River to California Ave. This will relieve a very congested portion of the city lying between Kinzie St. and Armitage Ave.

There will be other sewer work by the Sanitary District, as noted below.

Street Work

The Board of Local Improvements has an extensive program for street improvements and paving. This aggregates about 2,376,000 sq.yd., of which about 60% will be sheet asphalt paving. The Bureau of Streets (Walter G. Leininger, Superintendent) intends to resurface some of the macadam roads in the city with a bituminous-concrete pavement, and has ordered a portable railway asphalt plant for this work.

Drainage Canal and Accessories

The Sanitary District of Chicago contemplates letting contracts during 1914 for the construction of all of the Calumet-Sag Channel which is not now under progress. Advertisements for proposals on Section 12 have already been published and contract for Section 11 has recently been awarded. A summary of the work to be placed under contract during 1914 is as follows: Section 1 (connection to main channel), 6958 ft., $500,000; Sec. 11 (awarded), 5198 ft., $320,000; Sec. 12 (advertised), 4116 ft., $300,000; Sec. 13 (in Blue Island), [illegible] ft., $500,000; Sec. 14 (with controlling works and connection to Little Calumet River), 6400 ft., $600,000; total estimated cost, $2,220,000. The detailed quantities on most of this work have not as yet been computed, and, therefore, the estimated costs are only approximate.

In addition to the above contracts, work will be continued throughout 1914 on Sections 2 to 10, inclusive. The total value of the contracts on these sections is approximately $4,000,000. Dredging of the North Shore channel will be continued, as well as the enlargement of the main channel by dredging from Chicago to Summit. The costs of the work remaining to be done under these projects are respectively about $50,000 and $100,000.

Two contracts covering the construction of about four miles of intercepting sewers for the North Shore towns have been entered into, the cost of which will be about $320,000. An additional contract for North Shore intercepting sewers is to be awarded in the near future which calls for the construction of about six miles of sewers at an estimated cost of approximately $500,000. Work will be continued on the substructure and superstructure of Jackson Boulevard bridge, the cost of which will be about $375,000. Geo. M. Wisner is Chief Engineer; E. J. Kelly, Assistant Chief Engineer.

Track Elevation

The work of elevating the railway tracks throughout the city is being carried on continually under a comprehensive program. The work now under construction and proposed for 1914 covers 20.87 miles of roadbed and 106 miles of track to be elevated, and 137 subways to be constructed. The work is outlined as follows, from a statement furnished by F. J. Owens, Commissioner of Track Elevation:

Chicago, Milwaukee & St. Paul Ry.: (1) Bloomingdale Road, Ashland to Lawndale Aves.; (2) Evanston Division, Montrose to Bryn Mawr Aves. (Further details of this are noted later under the head of railways.)

Chicago, Rock Island & Pacific Ry.: main line, 76th to 90th Sts.

Chicago & Western Indiana R.R., main line, 81st to State Sts.

Pittsburgh, Cincinnati, Chicago & St. Louis Ry., and Baltimore & Ohio Chicago Terminal R.R.: Leavitt St., 69th to 39th Sts.

Chicago & Western Indiana R.R. and Wabash R.R., W. 75th St., from W. 74th to Wood Sts.

Illinois Central R.R.: main line, 100th St. to Kensington Ave. (as noted later on). Kensington & Eastern R.R.: E. 111th St. to Kensington Ave. Michigan Central R.R.: E. 113th St. to Kensington Ave.

In addition to this steam railway work, the Illinois Public Utilities Commission has ordered the Chicago & Oak Park Elevated R.R. to elevate its surface tracks now extending beyond 52nd Ave. The surface line is close beside the elevated tracks of the C. & N. W. Ry. and the trains cross the ends of the subways, making a very dangerous arrangement. Numerous accidents have occurred and the track elevation has been urged upon the company for several years, but it has pleaded poverty. The order of the Commission provides that plans must be submitted by July, and work started within 60 days after approval of the plans.

*Dependent on action of Sanitary District, which is to pay 50% of the cost.

†Over the west fork of the south branch of the Chicago River.

‡Over the Ill. & M. Canal (day labor).

Railways

Chicago, Milwaukee & St. Paul Ry.—During 1914, this road will complete the elevation of its double-track Bloomingdale Road line from Ashland Ave. to Lawndale Ave., 2.4 miles. About 40% of this work was done last season and during this year the remaining 60% will be completed, with the possible exception of some of the street-paving work. For 80% of its length this line is located in Bloomingdale Road, and the railway (by ordinance) is allowed to use 32 ft. of this street as right-of-way. The construction consists of mass concrete retaining walls on either side of the right-of-way, and reinforced-concrete subways at each intersecting or cross street. That part of the road not used by the railway is to be improved with brick pavement and concrete curb and sidewalk at the expense of the railway.*

At Robey St., near the east end of this track-elevation work, a new team yard of 55 cars capacity will be built. The present team yard at Elsmere near the west end of the elevation is to be increased from 30 cars capacity to 90 cars capacity, with provision made for future extension to 150 cars capacity; total estimated cost, $2,000,000.

The Northwestern Elevated Ry. operates on the C., M. & St. P. Ry. (Chicago & Evanston Division) from Wilson Ave. north to Linden Ave., Wilmette. From Howard Ave. (the north city limits) to Church St., in Evanston, these tracks are now elevated and an ordinance (July 11, 1910) requires the railway to elevate the tracks from Irving Park Boulevard (the second street south of Wilson Ave.) to Howard Ave. All of this work is required to be done by July 11, 1917. Active construction work on the south end of this line, from Irving Park Boulevard to Edgewater Station and Bryn Mawr Ave., has been begun. During 1915, tracks will be elevated from Bryn Mawr Ave. to Loyola Station, and during 1916 from Loyola Station to Howard Ave.

The right-of-way on this line is 60 ft. wide throughout and barely sufficient to accommodate four tracks and the necessary station platforms. It will be necessary to build full-height retaining-walls on either side of the right-of-way and reinforced-concrete subways the full width of the street at every intersecting street. The estimated cost of this track elevation is $3,850,000. Both pieces of track elevation above referred to are being done by company forces under the supervision of C. F. Loweth, Chief Engineer, with R. J. Middleton as Engineer of Track Elevation, and H. C. Lotholz, Engineer of Design.

A viaduct is to be built at Cleveland St., Mannheim (14 miles from the Union Station). The main structure will be about 280 ft. long with approaches about 550 ft. long each. The viaduct will cross 14 tracks, consisting of two main tracks and 12 tracks at the east end of the Godfrey yard. The main structure will be of steel on concrete piers, and the approaches will be constructed mainly of timber. The work is estimated to cost $90,000. It is under W. L. Webb, District Engineer.

Illinois Central R.R.—It is proposed to elevate the main line from Burnside (95th St.) to Kensington. A temporary grade will be adopted at the north end of the work, pending the separation of grades of the Western Indiana and Rock Island roads at Burnside. This approach will ascend on a grade of 0.45% from Burnside, enabling falsework to be driven to carry the tracks over 100th St., which will be the first subway from the north end of the work. This work will necessitate the construction of ten subways, two of which will be for footings only.

During 1914, it is proposed to place the entire embankment for this work, but to construct permanent subways only at 115th St. and Kensington Ave., the tracks at the other streets to be supported on falsework until next year. Permanent construction is necessary at 115th St. and Kensington Ave. on account of the connection with the Michigan Central R.R. and the Chicago, Lake Shore & South Bend R.R., requiring an interlocking plant, together with the necessary suburban and through station facilities. It is also the intention to elevate the Western line outside the city limits through Berwyn, and to rearrange and elevate the yard at that point.

The Chicago, Burlington & Quincy R.R. has very little work planned in this district, and the only important work is in connection with the proposed reconstruction of the union station. It is expected to elevate the tracks through Aurora, Ill., but this may not be started until 1915. The Chicago & Northwestern Ry. has nothing except the completion of the track elevation work at River Forest.

The Elgin, Joliet & Eastern Ry. has let a contract to Roberts & Schaefer for a 300-ton coaling station of concrete construction, with an elevating capacity of 75 tons per hour. This is at Dyer, Ind., and will be located between the main tracks, serving both tracks. At the same place it is rebuilding the pump house and equipping it with new pumping machinery operated with electric power. This includes deep-well pump, Curtis surface well pump, air compressor and motor to operate the water-treating plant recently installed by the Bartlett-Graver Co. The total cost will be about $28,000. There is very little other work in prospect, excepting some bridge and culvert renewals, which will approximate about $40,000.

Park Work

The three park departments have always a large and varied amount of engineering work, and the following is an outline of the work planned by the Commissioners of Lincoln Park (George D. Crowley, Secretary and Acting Superintendent). On account of the bond issue having been exhausted there will be no extension work done this year, but the new portion that has been reclaimed by filling with the hydraulic dredge will be graded, covered with black dirt and seeded. The portions of the paved beach that were destroyed by the storm of last November will be rebuilt, and this work will cost about $30,000. About 1000 lin.ft. of timber breakwater will be built in front of the old breakwater; the estimate for this is $28,000 and if more funds are available, possibly 2000 ft. will be built.

It is intended to cover about 20,000 sq.yd. of macadam walk with an asphaltic macadam surface. The paving of the Ohio St. extension is also contemplated. This road is paved with water-bound macadam, but it is intended to reshape it and cover it with a 2-in. surface of asphaltic concrete. There are about 30,000 sq.yd. of paving in this section.

*This work, with the construction plant employed, was described in "Engineering News," July 3, 1913.

Field and Office

Unusual Method of Bridge Erection

By Charles E. Clark, Jr.*

An unusual method of moving a bridge from its temporary to its final position was employed at Wood Ave., Linden, N. J., on the Pennsylvania R.R. The main girders, approach girders, and columns of a two-track structure were moved as a whole in one operation.

and the necessity of having always to keep four tracks in operation, the four-track bridge had to be divided in the middle. One section of two tracks was built 8 ft. off line and the other section, on the side where it was to be connected finally to this off-line section, was temporarily supported by the trough floor-plates resting on 12x12-in. stringers, which were held in turn by 12x12-in trestle bents.

To move the off-center section over the 8 ft., the

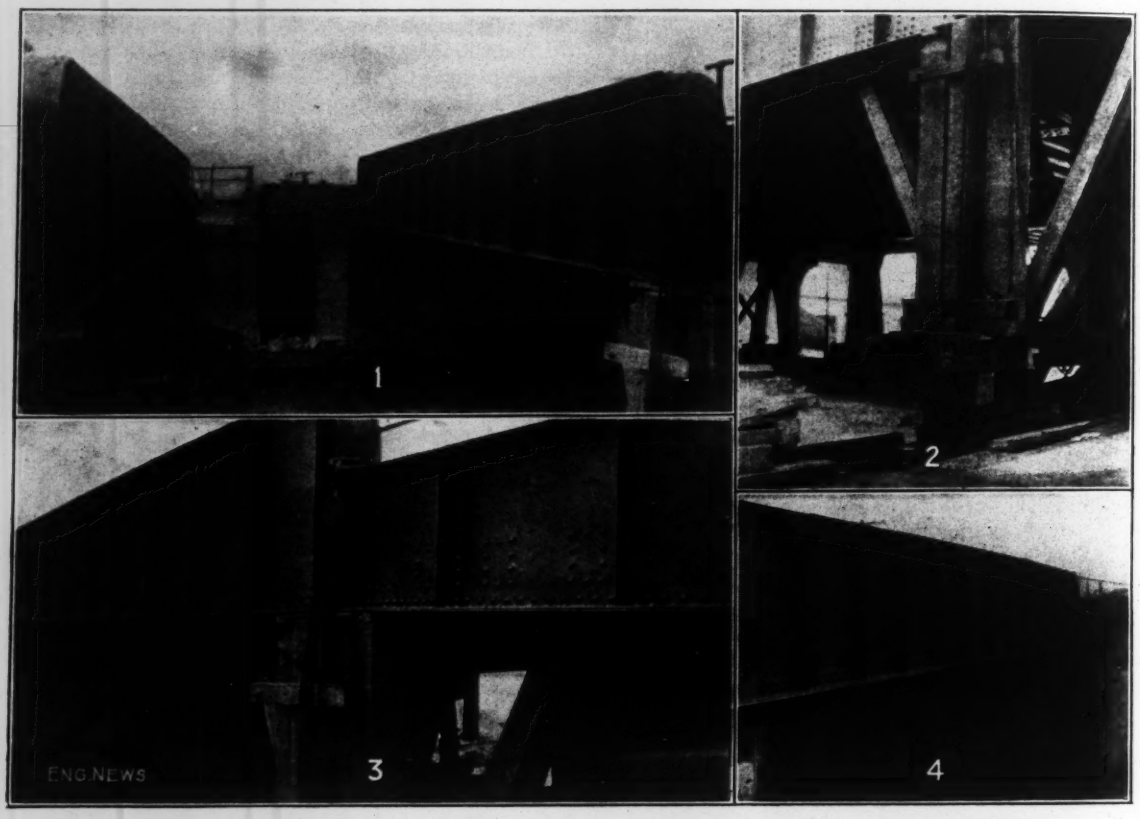

Plate-Girder Bridge Erection on the Pennsylvania R.R., Wood Ave., Linden, N. J.
(1) Two-track fixed span on left. (2) Jacks in place for raising span to be moved. (3) and (4) Moving span into place.

The new undergrade crossing consists of one two- and one four-track bridge. The bridges are half-through, consisting of main girders 52 ft. in length, and approach girders of a length of 16 ft. 6 in. Concrete abutments and foundations support these bridges. All the plate-girders are covered on the bottom and sides up to the cover-plates with an average thickness of 6 in. of concrete.

The two-track bridge, for the eastbound tracks, was built in its final position. On account of lack of space

structure as a whole was shored up on 12x12-in. timbers. The horizontal timbers on which the posts rested were held rigid each side of the bridge columns by tie-rods through the lattice work of the columns. The vertical shoring posts resting on these timbers supported the bridge as a whole.

Blocks supported the long bottom stringers. Under the blocks were placed 100-ton hydraulic jacks. With the system of shoring, shown in the illustrations, the bridge was lifted upon the column foundations, which were continuous, and later the whole structure was moved by means of rollers between 1-in. steel plates resting on

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the column foundations. The moving was done by jacks placed between blocks in a horizontal position.

Four hydraulic jacks were used in moving, two on either side of the street at the base of the anchored columns. Particular care was taken to have the movement the same on both sides of the street, so that the girders would be always parallel to the final center line.

The distance from the columns of the two-track bridge, which was anchored in its final position, to the new moving bridge, was checked up at frequent intervals on each side of the span.

The bridge moved with a steady uniform motion, not spasmodically; no racking of any parts was visible. In fact, so well was the shoring planned that not the slightest crack was perceptible in any of the concrete covering of the girders; although rails, ties and ballast were not removed beforehand.

One day completed the operation; the only interruptions were in placing the horizontal blocks; as the jacks were necessarily limited in their lateral motion. After the moving operation was completed, the bridge was again jacked up, plates and rollers were removed and the whole lowered and anchored to the foundations in its final position.

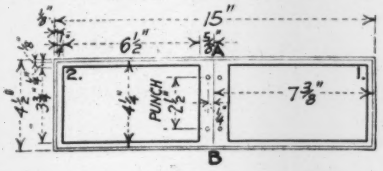

FIG. 1

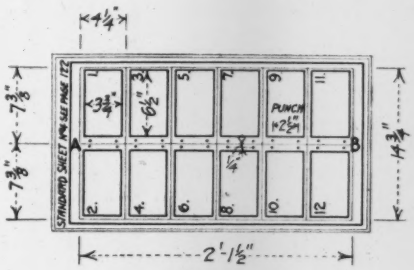

FIG. 2

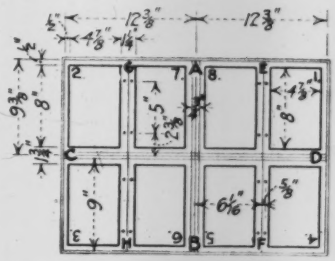
FIG. 3

FIG. 1. LAYOUT FOR 2-PAGE DATA SHEET. FIG. 2. LAYOUT FOR 12-PAGE DATA SHEET. FIG. 3. LAYOUT FOR 8-PAGE DATA SHEET

Blueprint Record and Data Sheets Printed on Both Sides of the Paper

BY F. J. TRUMPER*

In making up blueprint notebooks and data sheets, it is economy in both space occupied by files and in paper to make prints on both sides of the sheets, and blueprint paper coated on both sides is easily obtained. To those unfamiliar with printing-house methods the manipulation of the tracings and page forms to get pages that will read consecutively is often difficult. The following directions give the desired results.

RULING THE TRACINGS—Great care is necessary in ruling the borders on the tracings in order that the registering of border lines will be exact on opposite sides of the blueprint sheet. The best way to accomplish this is to use a large sheet of mounted eggshell paper and rule a template with fine lines of the standard sheet size, dividing it up into the required number of pages, care being taken to work from the center or folding lines. This paper is little affected by temperature changes and the border lines of the tracings will be more alike when traced from it.

PRINTING—The most simple arrangement for printing on both sides of the sheet is shown in Fig. 1. After making the first exposure in the regular way, without separating the tracing and blueprint paper, lay them on a table, tracing down. Turn the blueprint over, revolving it about the line *AB*, so that the unexposed surface of the blueprint paper will be in contact with the second page part of the tracing. Raise the tracing and the blueprint paper together and hold up to the light, the tracing next the observer, and register the border lines of the tracing with those faintly seen on the far side of the blueprint paper. Pin or clip the tracing and blueprint paper together along the margins, and make the exposure as before. With a little experience and care the fastening of the tracing and sheet together may be omitted.

The arrangement or layout for 12 pages is shown in Fig. 2. After making the first exposure of pages 1-9, inclusive, turn about the line *AB*, register the border lines and expose again for pages 2-12, inclusive. Fig. 3 shows a layout for 8 pages. Turn about the line *AB* as before. The line *CD* is for trimming. Fig. 4 is a layout for 18 pages. The line *AB* is the turning line as before, and the others are folding lines for trimming.

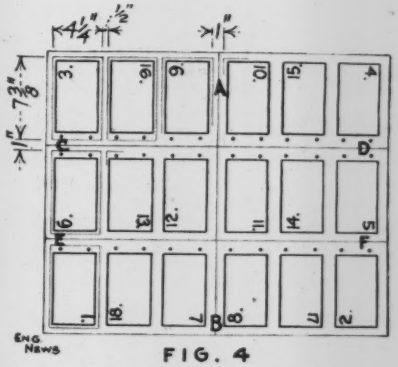

FIG. 4

LAYOUT FOR 18-PAGE DATA SHEET

TRIMMING—In the case of small-size data sheets, like those shown in Fig. 1, the trimming may be done with shears, straight-edge and knife, or better still, with a photograph trimming board. Where the large sheets have not been arranged with the hand-folding guide lines, as in Fig. 2, the sheets must have two adjacent outside border lines trimmed with straight-edge and knife or hand cutter, after which the job may be finished on a power cutter.

When the sheets are arranged as in Fig. 3, they are folded exactly on the lines *AB* and *CD*, stacked up and trimmed in a power cutter. In case standard-sized cut

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sheets are used for tracings and blueprint paper, the folding may be avoided and the trimming done direct.

BINDING—The data sheets shown in Figs. 1, 2 and 3 are designed to be loose leaves and may be inserted in ring binders. Fig. 4 is a layout which may have the leaves bound permanently in book form by folding along the lines *EF* and *GH*, instead of cutting on them, and then booking the folios thus formed in the regular way. This will insure the pages running consecutively without further arranging. This layout, of course, may also be made loose leaf by proper trimming.

Current Meters for Measuring the Flow in Large Pipes

By K. A. Heron*

The two accompanying sketches show current meters adapted to measure the flow in large pipes. Fig. 1 shows the ordinary current meter placed in a 48-in. wood-stave pipe to record the daily discharge. To place the meter the valve is closed, the top lid is removed and the meter rod is inserted through the loose disk and the packing box in the lid. The lid is bolted on with the meter in the upper 2-ft. section of pipe. The valve is then opened and the rod pushed down until a mark on it shows the

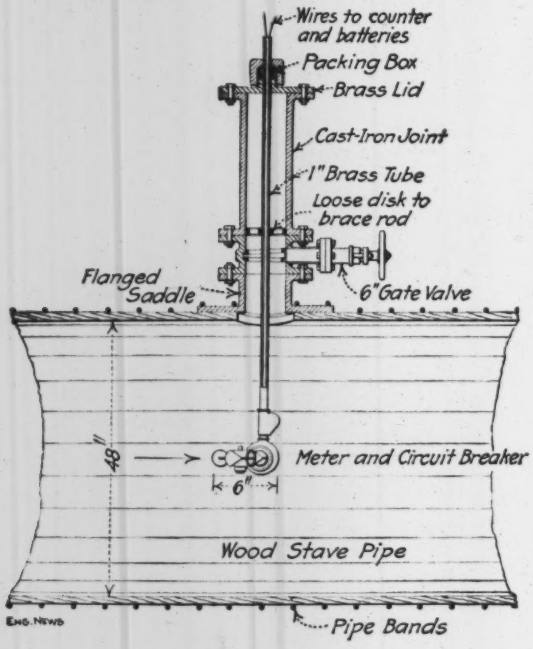


FIG. 1. METHOD OF USING CURRENT METER IN LARGE PIPE

(A meter is used, as here shown, on the outlet of Reservoir No. 2 of the water system of the Colorado Fuel & Iron Co. at Pueblo, Colo., to record the daily use of water of the company's steel mill.)

position of the meter with respect to the center of the pipe. The packing box is tightened to hold the rod in place. The meter is of the ordinary type with the wires inside the 1-in. brass tube or rod. The wires are connected to batteries and a counter and every tenth revolution of the wheel closes a circuit and is indicated by the counter.

This apparatus is suitable for long runs in certain waters. Waters carrying salts in solution are apt to cause deposits on the meter and clog the circuit breaker and movable parts. This is owing to the presence of the batteries which set up an electrolytic action and necessitate frequent cleaning.

A meter constructed similar to the one shown by Fig. 2 is the result of considerable study to avoid this clogging of the meter and to obtain a continuous record of

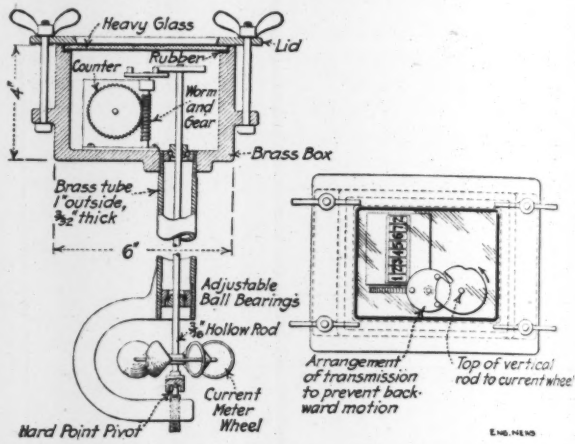


FIG. 2. MECHANICAL RECORDING DEVICE FOR CURRENT METERS

the pipe discharge. This meter is entirely mechanical in its operation. The battery wires are replaced by a small hollow rod about $\frac{3}{16}$ in. in diameter upon which the meter wheel is hung. The rod extends to a box on the top end of the 1-in. tube and is hung with ball-bearings at both ends. The box contains a counter driven by the meter wheel and is covered with heavy glass to withstand the internal pressure of the pipe. As in the meter first described, every tenth revolution is recorded.

To determine the relation between the mean velocity of the whole pipe cross-section and the center velocity a number of experiments were conducted at the steel plant of the Colorado Fuel & Iron Co., at Pueblo, Colo., where both meters have been in use for several years. The pipe was under approximately 100-ft. head and it was found that the mean velocity of the whole pipe area was very close to 81% of the center velocity. There was very little if any difference in velocity at points equally distant from the center of the pipe.

The meter last described is suitable to record the flow in large pipes. Once placed it requires very little attention unless the water is dirty, in which case the counter acquires a thin layer of sediment upon it and requires cleaning occasionally. Owing to the fact that all parts of the mechanism are floating there is no wear or tendency to collect dirt at the bearings. In clear water it should operate indefinitely and furnish a continuous record of the pipe discharge.

The experiments were conducted and the meters designed by A. A. Weiland and the writer under R. M. Hosea, Chief Engineer of the Colorado Fuel & Iron Co.

*Care of Modesto Irrigation District, Modesto, Calif.

Railway Cross-Section Calculations Simplified

By L. W. Wells*

Some 18 years ago, while on construction work on the Choctaw, Oklahoma & Gulf R.R., I had a vast amount of cross-section computations to make. While here, I worked out a short method, which is explained below.

The essential features of this method are that in all cross-sections we begin with the center cut or fill and multiply downward, both to the right and left, commencing with the first distance out to right or left; except in cases where the cross-section has a grade point in it, then we must begin our multiplications at the grade point. Finally, take the outside cut or fill readings and multiply them downward in the same manner into half the base. In case there are intermediate readings, multiply them in succession with the next distance out until we reach the outside readings, which in its turn, we multiply by half the base. Add the products of the right and left sides together and we have the double area of the section, if there are no intermediates (a 3-level section). But if there are any intermediate elevations, there will be an error in the work, which is corrected as follows:

Beginning at the center, which is 0.0 out, multiply upward to right and left the first distance out with the second intermediate cut or fill, until we have used successively each distance out and each intermediate. After adding these products, both right and left, we have a double error. Subtract this double error from the double area, as obtained above, and divide by two and the result will be the desired area.

The following examples may give a better idea and a better understanding of the above:

FIG. 1

EXAMPLE NO. 1, 3-LEVEL SECTION (FIG. 1)

Left		Center		Right	
c	b	a	j	i	We have:
0.0	2.0	2.0	2.0	0.0	
9.0	12.0	0.0	12.0	9.0	a × e = 24.0
d	e	f	g	h	b × d = 18.00
					a × g = 24.00
					j × h = 18.00

2)84.00 = Double area

Divided by 2 = 42.0 = Area

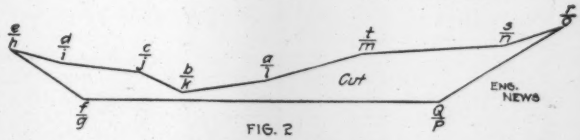


FIG. 2

EXAMPLE NO. 2. SECTION WITH ONE OR MORE INTERMEDIATES (FIG. 2)

Left			Center				Right		
f	e	d	c	b	a	t	s	r	q
0.0	2.6	2.0	1.5	0.4	1.0	2.5	3.0	4.0	0.0
9.0	12.9	10.0	6.0	4.0	0.0	5.0	12.0	15.0	9.0
g	h	i	j	k	l	m	n	o	p

We have:		To find error we have:	
a × k =	4.00	l × b =	0.00
b × j =	2.40	k × c =	6.00
c × i =	15.00	j × d =	12.00
d × h =	25.80	i × e =	26.00
e × g =	23.40	h × f =	0.00
a × m =	5.00	l × t =	0.00
t × n =	30.00	m × s =	15.00
s × o =	45.00	n × r =	48.00
r × p =	36.00	o × q =	0.00
	186.60		107.00

186.60 = Double area with error
107.00 Less double error

2)79.60 Divided by 2 = area

39.80

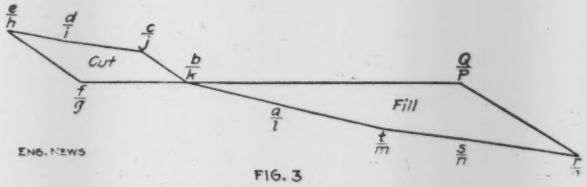


FIG. 3

EXAMPLE NO. 3. SECTION ON SIDE-HILL WORK HAVING BOTH CUT AND FILL AND WITH TWO DIFFERENT BASES IN ONE SECTION (FIG. 3)

Left			Center					Right	
f	e	d	c	b	a	t	s	r	q
0.0	2.6	2.0	1.5	0.0	2.0	2.5	3.0	4.0	0.0
9.0	12.9	10.0	6.0	4.0	0.0	6.0	10.0	16.0	10.0
g	h	i	j	k	l	m	n	o	p

We have for cut:		To find error we have:	
b × j =	0.00	k × c =	6.00
c × i =	15.00	j × d =	12.00
d × h =	25.00	i × e =	26.00
e × g =	23.40	h × f =	0.00
	64.20 = Double area of cut with error		44.00 = Total error
Less error	44.00		

Divided by 2)20.20 = Double area of cut without error

10.10 = Area of cut

To find fill we have:		To find error we have:	
k × a =	8.00	l × b =	0.00
a × m =	12.00	l × t =	0.00
t × n =	25.00	m × s =	18.00
s × o =	48.00	n × r =	40.00
r × p =	40.00	o × q =	0.00
	133.00 = Double area of fill with error		58.00 = Total error
Less error	58.00		

Divided by 2)75.00 = Double area of fill without error

37.50 = Area of fill

It is possible to shorten these cases by cancellation, but they have been given in full to keep them from being confusing.

A little study of the method given makes the proof clear. As at once becomes apparent, it is merely an adaptation of the well known method of computing areas by latitudes and departures, much used in survey work, of course, but so far as the author is aware, it has not been used before for the areas of cross-sections.

*Assistant to General Manager and Chief Engineer of the Texas Midland R.R., Terrell, Tex.

Short Method of Calculating End Areas for Earthwork—C. F. Koppisch, Resident Engineer, Southern New England R.R., Brimfield, Mass., after reading the article "A Method of Calculating End Areas for Earthwork Formulas," by E. S. M. Lovelace, in "Engineering News," May 28, p. 1200, sends us the following method of using the same data, which he believes to be preferable on account of using the exact cuts and fills with the corresponding distances from the center line:

Using Mr. Lovelace's demonstration of notes taken for Sta. 41 and Fig. 3, in "Engineering News," May 28, p. 1201;

Here his "grade rod" is 8.8, and deducting rod readings shown, most engineers will have notes like the following in their field books:

Sta.	Elev.	Grade	Left		C.	Right	
41	97.40	91.50	+1.7	+3.8	+5.9	+7.2	+6.4	+6.9
			12.5	8.0		6.0	13.0	20.4

Beginning at grade on the center line and going around the perimeter from left to right we have for plus quantities

$$\frac{(12.5 \times 0.0) + 1.7\,(10 - 8) + (3.8 \times 12.5) + 5.9\,(8.0 + 6.0) + (7.2 \times 13.0) + 6.4\,(20.4 - 6.0)}{2} = \frac{319.26}{2}$$

For the minus quantities we have

$$6.9\,(13 - 10) + (0.0 \times 20.4) = \frac{20.7}{2}$$

Then

$$\frac{319.26}{2} - \frac{20.7}{2} = 149.28 \text{ area.}$$

Cutting Piledriving Costs with a Gasoline Hoist

The "Pageant of St. Louis," which was presented in Forest Park, St. Louis, May 28-30, required a stage or a stage platform about 500 ft. long and 200 ft. wide. This stage was built entirely over water, touching the bank at each side, spanning a lagoon. Across the lagoon was a gentle even slope, forming a natural amphitheater which easily seats over 100,000 people. Taking part in the pageant itself were 7500 people, a troop of cavalry, artillery and many boats. The audience were presumably on the Illinois side of the Mississippi, looking across at the site of St. Louis, and following its growth from prehistoric mound-builder days to present times.

This platform for the stage was supported on piling placed 8 ft. c. to c. in both directions. At the rear, the floor level is 5 ft., at the front 2 ft., above the water. The piles were cut to proper elevations and a 6x12-in. beam, formed with two 3x12-in. timbers, with broken joints, was bolted to the side of the pile. Across this, 2x8-in. joists were laid, 16 in. c. to c. The decking was 2x10-in. square-edge timber.

For the pile substructure, which was started Feb. 15 last, the lowest bid received by the Park Department, which had entire charge of this work, was 22c. per ft. The next highest bid was 36c. Nelson Cunliff, Supt. of Construction of the Park Dept., who has had charge of the design and construction of the stage and structural work, estimated that the work could be done for 17c., and, accordingly, the work was undertaken by force account.

In this work, time was essential. An accompanying curve, Fig. 2, shows the schedule and actual record of driving piles; the straight light line shows the schedule laid out for driving piles, the curved line the actual record of driving. In starting, the piles had to be driven through holes cut in the ice. In fact, all the preliminary work, the survey, etc., was laid out on the ice.

The estimate called for driving 17,105 lin.ft. of piling at a cost for labor and equipment of 17c.—a total cost of $2907.85. This assumed an average length of pile of 13.15 ft. While 1326 piles in all were driven, with a total length of 19,104 ft., averaging 14.4 ft., 25 piles were out of line, and the following figures are based on a net of 1301 piles, or 18,735 lin.ft.

The total cost of the piling at 7.5c. per ft. delivered on the job was $1432.80; the total payroll was $[illegible]3.92; the 6½-hp. gasoline engine and hoisting outfit $[illegible]340; and the cost of the scow, leads, etc., $154.

Allowing 100% depreciation on the hoisting outfit and derrick, the labor cost for driving 18,735 ft. of piling was $2148.38 or 11.5c. per ft.

Allowing, however, a depreciation charge of 20% of the cost of the equipment, and 15% of the labor cost to take care of overhead charges, the total cost of driving the piles was approximately $2000, or 10.7c. per ft. With the pile costing 7.5c. the total cost was 18.2c. per ft.

On this work, union men were employed, at the following rates:

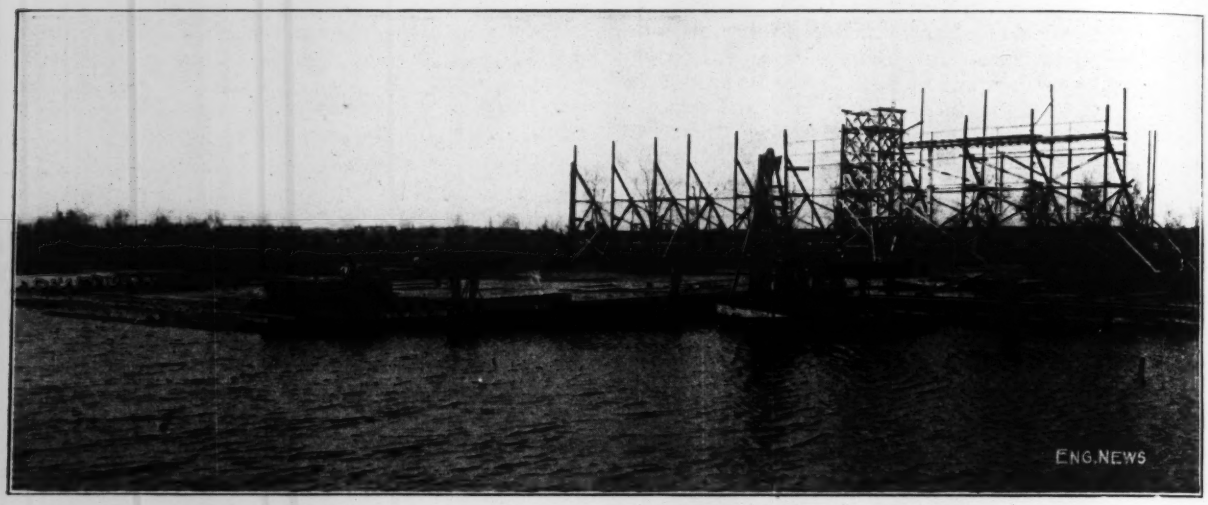


FIG. 1. BUILDING A GREAT STAGE IN A PARK LAGOON
(A general view of the platform on which the "Pageant of St. Louis" was staged, Forest Park, St. Louis.)

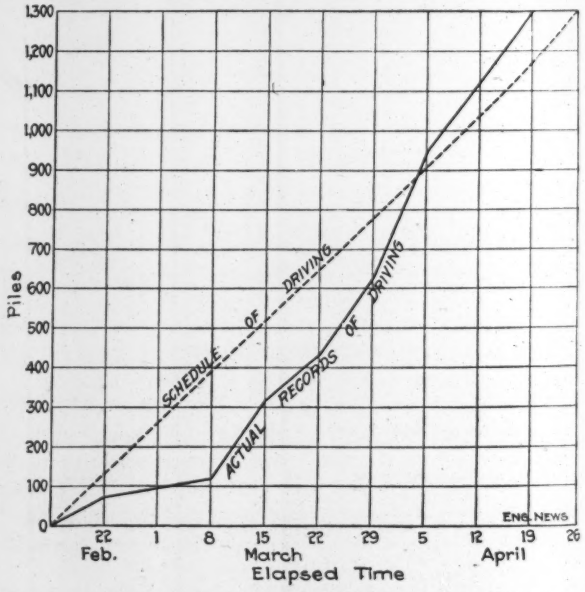


FIG. 2. CURVE SHOWING THE SCHEDULE AND ACTUAL RECORD OF DRIVING PILES IN FOREST PARK, ST. LOUIS

Hoisting engineer, 80c. per hr.; piledriver foreman, 75c. per hr.; piledriver laborers, 40c. per hr.

The driver leads were 20 ft. high, built with 6x6-in. timbers, braced back to the rear portion of the scow. The hoisting equipment, built by the Whitman Agricultural

FIG. 3. SMALL PILE DRIVER EQUIPPED WITH GASOLINE ENGINE AND A DROP HAMMER

Co., St. Louis, consisted of a 6½-hp. "Sultan" reversible gasoline-driven engine, geared into two drums with necessary controls, etc. A winch head, on the hoist, was used to pull in the piles. The weight of the drop hammer was 1650 lb. The scow was 14x16 ft. and 3 ft. deep.

An Economic Pile Extractor

A pile extractor following the general design of an inverted steam pile hammer was recently placed on the market in England. The base of the extractor is clamped directly to the head of the pile to be withdrawn; and the piston of the inverted hammer, or better termed the "jerker," delivers blows upon an anvil-block above. The effect of these blows is transmitted from the block through the connectors *D* to the grip-box *E*. The grip-box holds the pile *G* very tightly by means of the wedges *F*.

Just before striking the anvil base, the piston *A* in its upward travel closes the steam valve by contact with the lever *J*, which intrudes into the cylinder. In descent, when near the lowest position, the intruding lever *K* is struck, and the admission valve opened. The steam at from 80 to 100 lb. pressure per sq.in., is conducted to the cylinder through flexible piping. The connection between the levers *J* and *K* and the admission and release valves below is shown in the middle detail of the figure.

The rapid jerking of this operation sets the whole pile in vibration, lessening the skin friction between pile and ground. It is claimed that a timber pile, penetrating 30 ft. into a mixed stratum of sand, gravel and boulder clay can be withdrawn in about two minutes.

The extractor is suspended from a pile frame or derrick. The rod *P* runs through the center of the cylinder to the suspension ring *H* which, therefore, takes the

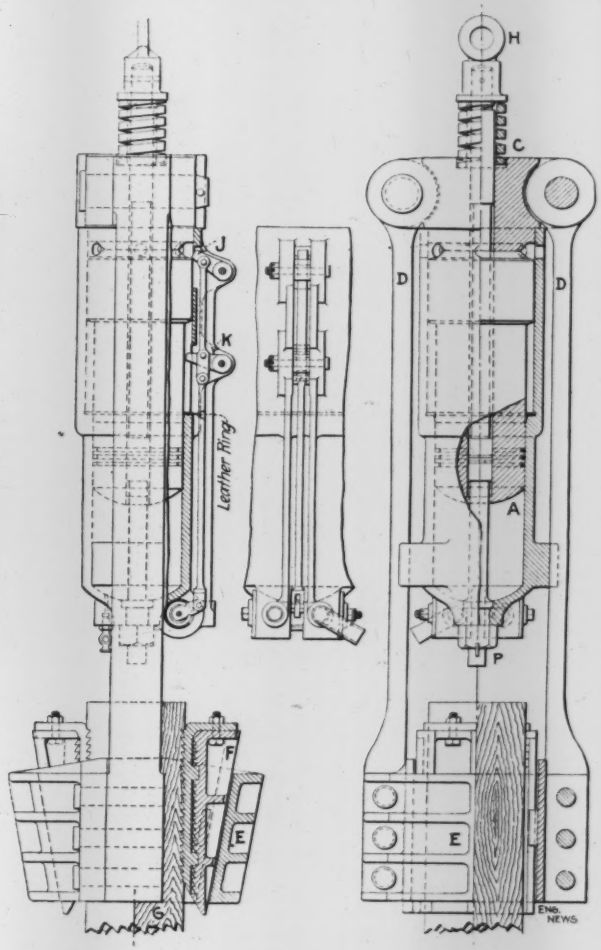


DIAGRAM OF THE RANSOME-VER-MEHR PILE EXTRACTOR

weight of the cylinder. The overall height of the machine is about 5 ft.

The extractor was developed by the Ransome-ver-Mehr Machinery Co., Ltd., Brunswick House, London, S. W., and is sold only by that company. The machine was described in *Engineering*, of May 1.

A Six-Mile Railroad with a Steel Bridge To Be Removed—The removal of the Coalport R.R., a six-mile coal-carrying line extending from Barbourville, Ky., to the Coalport coal field, was scheduled for commencement about May 20. The entire line including a $20,000 steel bridge across the Cumberland River was sold to a local dealer for less than $10,000. The line has been in operation about 15 years. The working out of the coal measures in the Coalport field destroyed the traffic of the road. The steel bridge has been bought by Bell County, Ky., and according to local reports will span Yellow Creek.

Comparison of Weir Discharge as Computed by Four Standard Formulas*

A 26-ft. sharp-crested weir used by the Brooklyn, N. Y., Bureau of Sewers for measuring the flow of a large trunk sewer was described in ENGINEERING NEWS, of Apr. 9, 1914. As stated there the formula used to compute discharge was the Bazin formula

$$Q = mLh\sqrt{2gh}$$

for suppressed weirs with a velocity of approach. Since this weir is probably the largest sharp-crested weir ever experimented with, and its discharge, 18,000,000 gal. per day (28 cu.ft. per sec.), very large, it is of interest to compare its computed discharge by the four standard weir formulas.

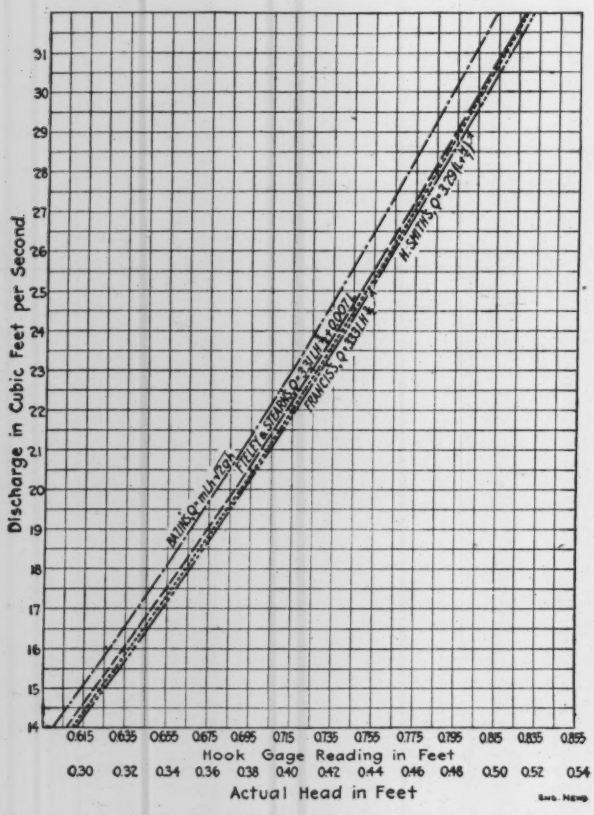

Discharge in Cubic Feet per Second
Hook Gage Reading in Feet
Actual Head in Feet
BAZIN, Q = mLh√2gh
FRANCIS, Q = 3.33(h - 0.1h')
H. SMITH, Q = 3.29Lh^1.5
HAMILTON SMITH, Q = 3.33Lh^1.5
ENG. NEWS

DIAGRAM SHOWING DISCHARGE OF A 26-FT. SHARP CRESTED WEIR COMPLETED BY FOUR STANDARD FORMULAS

In the Bazin formula adopted for the sewer discharges

Q = cu.ft. per sec.;

M = constant $= 0.425 + 0.21\left(\frac{h}{P+h}\right)^2$;

h = head on crest in feet, not corrected for velocity of approach;

L = length of crest in feet;

g = acceleration by gravity;

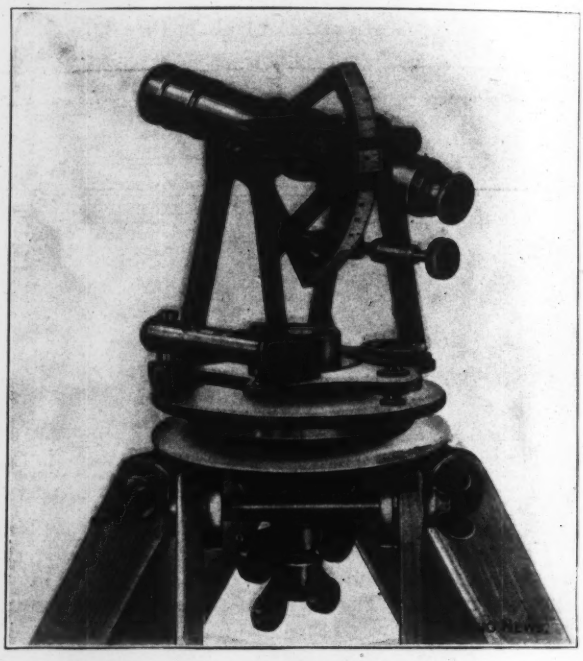
P = depth of channel of approach below crest of weir.

*Data from Geo. T. Hammond, Engineer of Design, Bureau of Sewers, Brooklyn, N. Y.

This gives the largest discharge of the four formulas; the comparison of the four is shown graphically in the accompanying diagram, or in percentages taking the discharge by Bazin formula as 100%, we have by Fteley and Stearns 96.2%, Francis 95.6%, and Hamilton Smith 95%. In each of the latter three formulas H = height above crest of weir to level of still water and L = the length of the crest in feet.

Stadia Instrument for Measuring Earthwork

The accompanying illustration shows a new instrument designed to facilitate the cross-sectioning of railway cuts and fills, for estimating earthwork quantities. The plate is leveled by means of a ball-and-socket joint, like an old-time staff compass, and is clamped by the upper of the two winged nuts shown beneath the head. The head carrying the telescope and levels moves in azimuth and is clamped by the lower winged nut. The vertical arc is an adaptation of the well known Beaman stadia arc, invented and patented by W. M. Beaman, a topographer of the United States Geological Survey, and used on plane-table alidades by the Survey for several years (see ENGINEERING NEWS, May 23, 1912, p. 989).



STADIA INSTRUMENT EQUIPPED WITH BEAMAN ARC FOR MEASURING EARTHWORK

To use the instrument the tripod is set in the middle of the roadbed at a station point, or when necessary in order to see over both sides, a setting is made near each edge of the roadbed. The plate is then leveled by the center circular level and finally by the tubular level, for which a leveling screw is provided as shown. The instrumentman sets the middle stadia wire at any point on a rod held perpendicularly at the toe of the slope, or the top of the slope in cuts; reads and records the readings of both the indexes of the arc (for percentages of vertical and horizontal distances), the rod intercept, the middle

wire reading on the rod; measures the width of the roadbed between settings, if two settings are made, notes the whole width of roadbed and the height of instrument—and he has obtained all the data necessary for computing the area of the cross-section through the station; for the distance from instrument to toe of slope and the height of fill (or cut) are easily reduced from the stadia arc readings.

The instrument illustrated is made by W. & L. E. Gurley, Troy, N. Y., who control the patent on the Beaman stadia arc.

Steel Guyed Derrick for Bridge Erection

The erection of two of the four towers for the twin cable-lift drawbridges of the Pennsylvania Lines over the Calumet River, at South Chicago, Ill., was effected with the aid of a steel guyed derrick of 30 tons capacity, having an 85-ft. mast and 70-ft. boom. Owing to the construction of the tower posts, it was decided to erect one tower on each side of the river with a guyed derrick. The second or twin tower on each side was erected with a boom carried by one of the tower posts as a mast, as described in ENGINEERING NEWS, Sept. 11, 1913. The towers are 31 ft. 3 in. by 41 ft. 3 in. and are on a skew of 50° with the channel.

The construction of the derrick is shown in Fig. 1. The mast is of H-section, composed of two 24-in. I-beams and an 18-in. I-beam, with double lacing over the flanges of the larger beams. The cast-steel spider is 27-in. diameter with 14 holes and a 5-in. pin. Eight guys were used, of 1⅛-in. plow-steel cable, four having a spread of only 16 ft. from the center of the mast and four having a spread of 22 ft. The spider seems rather small for the size of the mast, the explanation being that while the derrick was new the spider was an old one which the contractor had on hand and wished to use. It is secured to a cast-steel mast head.

The foot of the mast has a phosphor-bronze bushing (6-in. radius) resting on a hemispherical bearing on the foot block. The boom is composed of a pair of 18-in. I-beams, 18¼ in. c. to c., with cross frames between them, and with double lacing and cover-plates over the flanges. It turns on a 3½-in. pin in the boom-shoe on the mast and can be raised to a vertical position against the mast as shown.

The bales and pins at the head of the boom, Fig. 2, seem rather disproportionate, but it is stated that they were designed to take care of the bending moment on them when the boom and load were topped up close to the mast to turn under the guys, as shown in Fig. 1. It was necessary to boom a 16-ton load up close to the mast for two lifts in each tower, and then to turn the derrick under the guys. The guys then failed to clear the mast by about ½ in., as had been calculated, and had to be pried over the corners of the mast. This gave no trouble, however. The loads in question were top sections of the tower columns.

The derrick was placed in the center of the tower, the falsework being built around it. The derrick was moved four times for each tower. In making the move, the mast first raised the boom, and then the boom was guyed and used to raise the mast to its new position. In two of the positions, the derrick stood on 10-ft. pony bents on top of the regular falsework bents, and four of the guys were then secured 6 ft. below the heel of the mast. The hoisting and topping cables were of ⅝-in. steel, with ten parts in the hoisting falls and eight parts in the topping lift.

The mast is built in three sections, with the splices so made that the center piece can be omitted and the mast used for a stiff-leg derrick. The splice in the interior 18-in. I-beam is about 26 in. below the splice in the exterior or main 20-in. I-beams. The splice is shown in Fig. 2.

For information as to this derrick and its work, we are

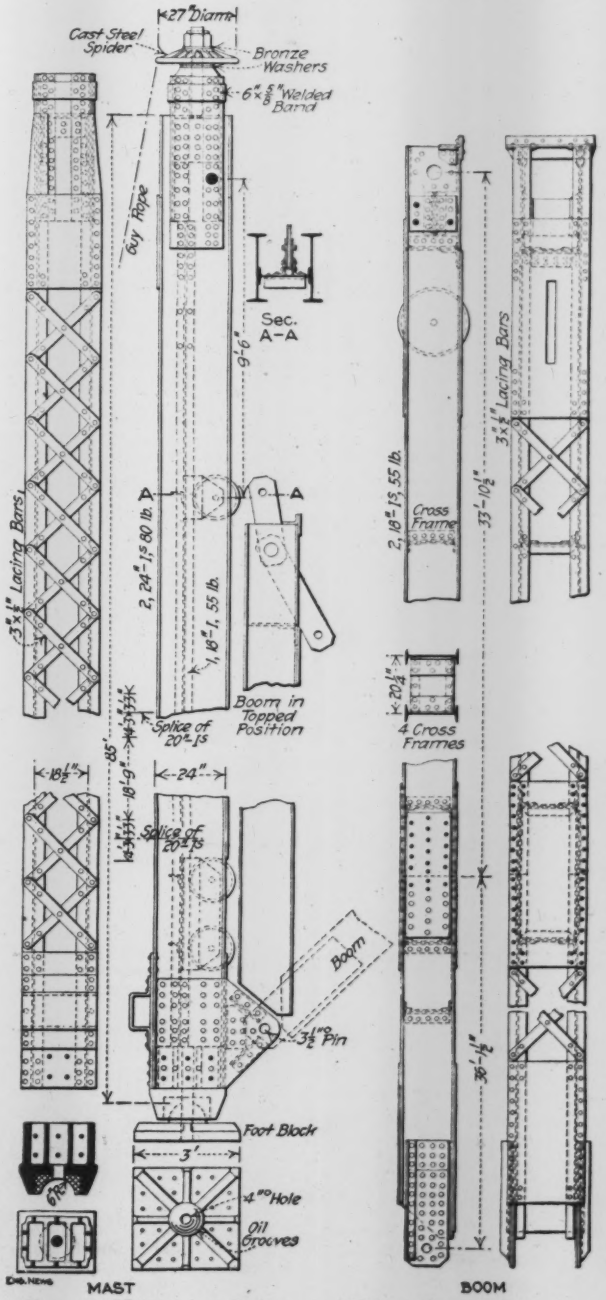


FIG. 1. MAST AND BOOM OF 30-TON STEEL GUYED DERRICK FOR BRIDGE ERECTION

indebted to W. J. Howard, of the Kelly-Atkinson Construction Co., of Chicago, which company had the contract for this erection work. It was built by the Ameri-

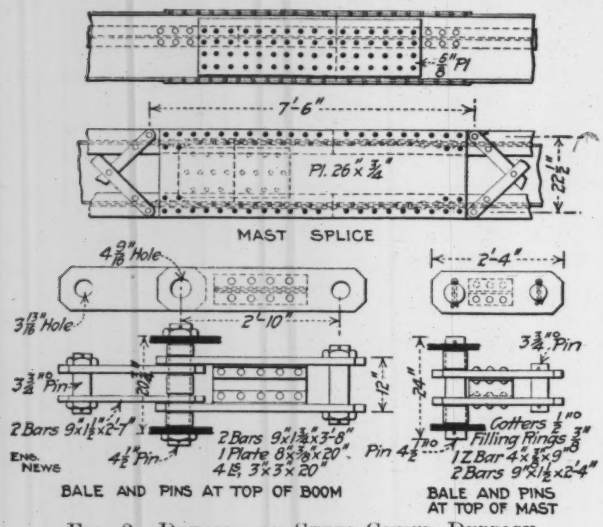


FIG. 2. DETAILS OF STEEL-GUYED DERRICK

can Bridge Co. Guyed derricks of 30 and 20 tons capacity, but with masts and booms of box-lattice construction, were described in our issue of Nov. 20, 1913.

NOTES

Fifth Root by the Slide-Rule—Charles N. Pickworth, of England, author of the book "The Slide-Rule," contributes the following:

In your issue for Dec. 25, 1913, you described Prof. Pardoe's method of finding the fifth root by the slide-rule, at the same time inviting accounts of other processes. I have recently employed two methods, which I have not seen described and which may be of interest in this connection.

(1) Take the fourth root (i.e., sq.rt. of sq.rt.) of the number as an approximate value. To this value on D set 1 on C and over the same value on B take the reading on A. If the latter agrees with the reading on B under the original number on A, the approximate value is correct; otherwise move the slide until agreement is secured. It will be noted that the slide only is moved; there is no actual need to use the runner, all the readings being made on adjacent scales.

(2) Invert the slide and set 1 on C to the number on A. Find a value n (approximated by finding the fourth root as above) on A which is in agreement with n^2 on C^1 (i.e., C inverted) using the runner on the scales on the stock of the rule to obtain values. By this method the slide is not moved. The first method is, however, more convenient.

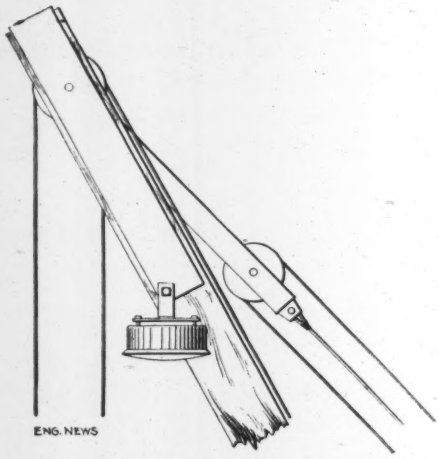
It should be remembered that with such methods as these, five roots are possible for the same significant figures (each being about 2 in. from the next on a 25-cm. rule).

I have described other methods of finding unusual roots in the twelfth edition of my little book "The Slide-Rule."

A 4000-Ton Stone Crushing and Screening Plant—There was recently put in operation about two miles south of Birdsboro, Penn., a thoroughly uptodate stone-crushing plant, which has a daily capacity of 4000 tons. The quarry yields a hard tough trap rock, weighing 184 lb. per cu.ft., which is loaded by steam shovels on steel cars and hauled to the crusher by steam locomotives. The largest of the series of crushers will receive and crush a 12-ton block, and is claimed to be the largest crusher now in use in a trap-rock plant. The covered and open storage facilities afford a total storage of 250,000 tons. The stone is, of course, handled exclusively by loading and conveying machinery. The plant is owned and operated by the Birdsboro Stone Co., Philadelphia, Penn.

Derrick with Searchlight to Illuminate Its Work—In hurrying their wory on the Perry Memorial, a 300-[illegible] granite shaft at Put-in-Bay, Ohio, the contractors, A. B. R[illegible]son & Son, of Chicago, have been doing some stone-setting at night. Good illumination is required in such work. To get a strong light directly over the point of working, the contractors attached a searchlight to the derrick-boom, near the outer end, just alongside the hoisting line.

The rig is about as sketched in the adjoining cut. The



light is fastened to the boom by a strap-iron angle-bracket, held by one bolt. The idea was to secure a pivoting or suspension effect, making the ray of light vertical, i.e., directly down on hook and load, in all positions of the boom. The strap binds enough to prevent free pivoting, however, and where it is an important object to maintain the ray vertical a more carefully designed attachment would have to be constructed. In the present case, the topping movement of the boom is slight, and the ray of light remains nearly vertical even though the searchlight does not swing. Quite a bit of night stone-setting has been done.

A Boxed Howe-Truss Highway Bridge—Until recently through Howe-truss highway bridges, entirely roofed and boarded up, were common sights on New England roads. A covered Howe-truss bridge of a different type is shown in the accompanying views. This bridge, known as the Whipple Bridge, spans the Blackstone River between the towns of Cumberland and Lincoln in Rhode Island, and was built in 1870. It is 200 ft. long overall. The trusses are boxed throughout. The truss timbers are in a very fair state of

FIG. 1. AN UNUSUAL TYPE OF HOWE-TRUSS HIGHWAY BRIDGE

FIG. 2. OLD HOWE-TRUSS HIGHWAY BRIDGE, BLACKSTONE RIVER, RHODE ISLAND

preservation considering their length of service, due undoubtedly to this unusual method of protection from the weather. The flooring system, however, is now in poor condition due to the rolling of many members, especially on their lower sides. They have been repaired from time to time, but the bridge is not now safe for loads exceeding three tons weight. The State Board of Public Roads has recommended a new structure of reinforced concrete. [Photographs from Peter J. Lannon, State Board of Public Roads, Providence, R. I.]

An Easily Constructed Stadia Rod—C. H. Eiffert, of Windes & Marsh, Civil Engineers and Surveyors, Winnetka, Ill., sends the following directions for constructing a serviceable stadia rod, shown in the accompanying illustration: The central portion of the rod with the figures and graduations is a "Chicago" rod ribbon glued to a 5-in. wide hardwood board backed

AN EASILY CONSTRUCTED STADIA ROD

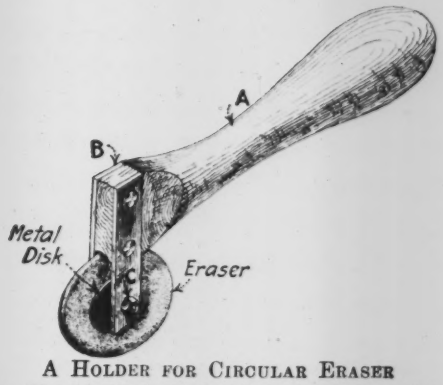
with a tapered longitudinal wood rib. Of the rod ribbons there are several styles, the one shown having probably the boldest figures, and as the hundredth marks become a blur at long distances the half-tenth graduations were considered preferable. The rod shown can be read far beyond the point where the figures are legible, for the foot and half-foot marks stand out clearly at long distances. A white card tacked with its upper edge on the 5-ft. mark was found to be a great aid in reading long shots, and was also used in setting for vertical angles. Distances up to 1200 ft. were read regularly with the rod shown, and in many instances where greater accuracy was not required, the half stadia interval was used and the rod read at distances up to 1800 ft. The colors outside the ribbon were black and white only.

Maximum Gradients for Various Types of Pavements have been adopted by the New York State Highway Department as follows:

Wood block, 2%; asphalt block, 4%; brick, 5%; concrete, 5%; bituminous macadam with flush or squeegee coat (in sandy country, 6% when coarse sand is sprinkled on the surface), 5%; bituminous macadam without squeegee coat, 7%; waterbound macadam, 8%; "Hillside" brick 12%; stone block with open joints, 12%.

Grades of greater than 7% are not to be decided upon except with the approval of the Division Engineer.

Handy Holder for Circular Erasers—The accompanying illustration shows a draftsman's kink devised by John E. Cahill, 795 E. 182nd St., Borough of the Bronx, New York City. Mr. Cahill writes that the device is to save damage to the thumb and fingers and to utilize all the eraser that



A HOLDER FOR CIRCULAR ERASER

will rub. The handle is made of wood and the plates B of strips of brass or copper. The screw and nut C hold the eraser, pinched between the two plates B. When the rubber is worn down to the metal disk, the disk can be removed and the remainder of the eraser used. The whole device is home-made and not patented.

Diagram for Estimating Earthwork in Trenches—The accompanying diagram, sent us by R. L. Holliday, 477 Columbia Ave., Palmerton, Penn., is so simple that it is not unlikely that other engineers have made use of a similar one. It can be quickly plotted by any draftsman. The diagram shows cubic yards of earthwork per lineal foot of trench (having vertical sides) for various widths of trench and depths of excavation in feet. For rapid preliminary estimate computations it has proved very handy.

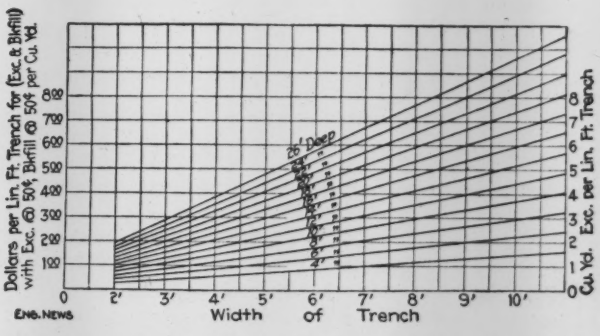


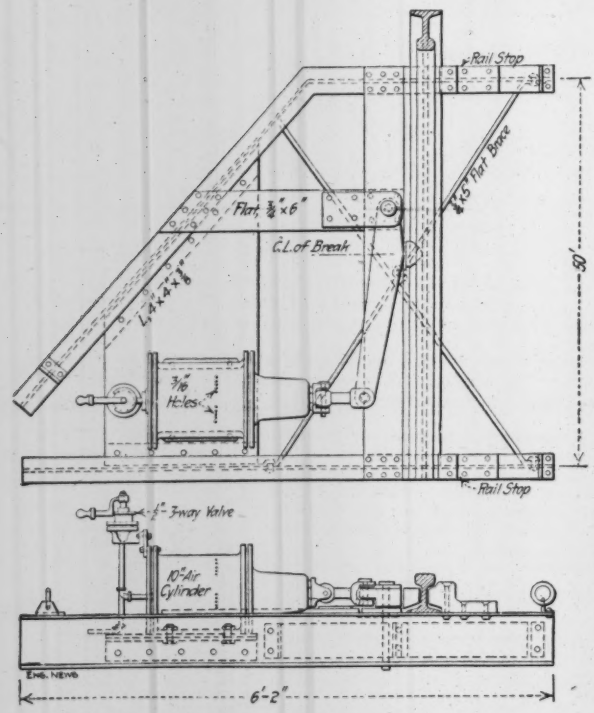
DIAGRAM SHOWING CUBIC YARDS OF EARTHWORK PER LINEAL FOOT OF TRENCH

The Mystery of a 40-Link Surveyor's Chain—Richard S. Kirby, of the Department of Civil Engineering, Pennsylvania College, Gettysburg, Penn., writes us as follows:

I am interested to learn whether or no any of the older members of the profession have ever used a two-rod chain divided into 40 links of about 10 in. each. Such a chain has recently come to light, and was used for purposes of instruction by several successive generations of professors of mathematics. The chain is, of course, of wrought iron, and is evidently the work of an expert chain maker. It is divided into five parts, as ordinary chains were, by brass markers, which are therefore eight 10-in. links, or ten real links apart. My mathematical friend assures me that it is altogether possible to make an accurate chain survey with this instrument, and in the light of his superior knowledge I do not argue with him, but I am still in the dark as to the purpose of the designer of the chain.

Quick Bending of Steel Rails is accomplished at Balboa, Canal Zone, by a machine recently designed and built there and described in the "Canal Record" of Apr. 22. It is used in the preparation of old rails for reinforcement in the concrete construction of the proposed Dry Dock No. 1 at Balboa. The accompanying plan and elevation illustrate this simple method.

Mounted on a base built of braced 8-in. I-beams covered with ¾-in. steel plates, is a 10-in. air cylinder with a 10-in. stroke. The piston is joined to a heavy iron bar 2 ft. 4 in. long, the other end of which is set in a stationary pivot alongside the rail. Near this pivot a wedge-shaped block of steel is attached to the bar, the other face fitting between the flanges of the rail to be bent. The forward stroke of the cylinder thrusts the wedge-shaped block against the web of

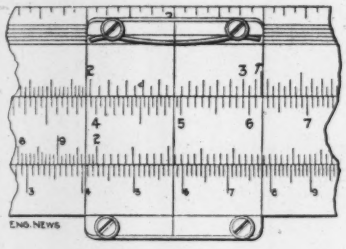


PLAN AND ELEVATION OF SIMPLE RAIL-BENDING MACHINE

the rail midway between the two rail stops on the sides of the base. The thrust of the piston is sufficient to bend the rail to a considerable curvature. Furthermore, when the rail is under stress, it can be broken by the sharp blow of a sledge hammer applied opposite the point of contact of the block.

The machine is portable and weighs about 650 lb. It can be supplied with air by connecting the cylinder to the air-brake system of a locomotive or train. In applying it to railway construction, it should be stated that a rail thus broken must be finished with a cold chisel before making a joint in laying track.

Bending Reinforcing Rods is accomplished very simply and satisfactorily at Balboa by an arrangement somewhat similar to the rail-bending machine. The rods are bent by the thrust of the piston rod of an engine cylinder while the rods are held in place on a table in front of the cylinder. The table is a steel plate bored with numerous holes, wherein are placed movable steel pegs for limiting the bending. Two such equipments are in use; one includes a single 10-in. cylinder recovered from an old French locomotive. This outfit places a single crimp in three or four ¾-in. rods simultaneously. The second equipment employs two 14-in. cylinders taken from the dumping mechanism of a 2-cu.yd. concrete mixer, which are mounted on opposite sides of the table and make opposite bends in rods as large as 1¼ in. in diameter. In both cases, compressed air is used at a pressure of about 80 lb. per sq.in. It is claimed that five men in one hour can bend as many rods as they formerly did in eight hours.



A New Slide-Rule Runner—The accompanying illustration shows a new "frameless" slide-rule runner. The disadvantage of the old-style runner in hiding the figures adjacent to the hair line is too well known to all users of a slide-rule to need elaboration. It is claimed that the new runner greatly increases the ease and rapidity of using the rule. The new type is made and patented by the Keuffel & Esser Co., Hoboken, N. J.

Cellar Excavation with Power Scraper—In excavating recently for the large Occidental Realty Building, at Indianapolis, Ind., the contractor (H. W. Klausman) used a power scraper as the most adaptable tool. The site, at Illinois and Washington St., is narrow (40x200 ft.), and with the scraper engine set up at the street end, practically the entire area could be covered by the bucket, leaving only the front corners to be cleared out by hand. The bucket (Sauerman) discharged through a screen rack at sidewalk level into the leading hopper of a bucket hoist which lifted the dirt into a team bin over the roadway. The view herewith shows the plant as seen from the back end of the lot.

CELLAR EXCAVATION WITH POWER SCRAPER

Blasting a Drainage Ditch 2600 Ft. Long containing 1732 cu.yd. was described in the "DuPont Magazine" for June, by B. L. Jenks, Secretary of the American Land Co. The work, which was performed last summer, required the use of 1400 lb. of 60% nitroglycerin dynamite. The propagation method was used, i.e., only a center hole in a line 300 to 500 ft. long was primed with fuse and cap. The total cost was $383 or 22.1 cents per cu.yd., itemized as follows: dynamite delivered on land, $278; labor (putting down the holes and shooting), $104; fuse and caps, $1.

Mr. Jenks states that as the land was very wet it would have been impossible to have used teams or a ditching machine and that to have dug it by hand would have cost at least 33 cents per cu.yd.

Breaking Retorts with Dynamite is described by W. W. Weimann, of Emporium, Penn. Cast-iron retorts weighing 6000 lb. each were easily and safely broken by means of a stick of 40% dynamite, 1¼ in. in diameter and 4 in. long, and one electric blasting cap to each retort. A retort to be broken was first filled with water and the cartridge suspended within and shot.

Editorials

Air Propellers for Canal Boats

The extensive use of the air propeller for driving aëroplanes is giving rise to various proposals for and occasionally to actual trials of the propulsion of vessels through the water by the same means. Particularly in Europe have a number of experiments been made on various canals, and on p. 1336 of this issue a note describes one of the latest tests in England. The limitations to success in any such experiment are so well established that they ought to be generally understood by engineers. An air propeller drives an aëroplane with a fair degree of efficiency because of the high speed at which the aëroplane moves; but when the engine and propeller of the aëroplane are transferred to the deck of a boat, which runs at perhaps a third or a quarter of the speed of the aëroplane, or even less, the efficiency of the air propeller falls off to a very low figure.

The action of a screw propeller working in air, like that of a screw propeller working in water, or of a paddle wheel, for that matter, is to drive a current of fluid astern. The work expended in turning the shaft of the propeller is divided into two parts; one part is expended in driving a current of water or air at high velocity astern, and the other part is expended in driving the vessel forward. If the vessel is moored to a dock, the efficiency of the propeller in driving the vessel forward is zero, since all the work done by the propeller is expended in driving the current of water astern and the vessel is driven forward not at all. Very brief study and computation will show that the propeller, whether working in air or in water, will attain its highest efficiency when the vessel is driven forward at high speed and the current of air or water driven astern is moved at low speed. The specific gravity of air is so small, however, that in order to get any considerable amount of thrust from the propeller, the current of air sent astern has to be moved at high speed. Even under the conditions of aëroplane operation, therefore, the efficiency of the air propeller is generally very low.

A Unique Port

A spectacle that could be duplicated at no other seaport in the world was seen on the North River at New York City last Friday when the "Aquitania," the new monster ship of the Cunard line, came up the river to its pier at 14th St. While this second largest vessel in the world was being docked, the "Imperator" of the Hamburg-American line, which made its maiden voyage only a year ago and is of about the same size as the "Aquitania," was lying just across the river at the Hamburg-American pier in Hoboken.

Not only is New York the only seaport in the world outside of Europe to which these huge vessels sail, but there are in Europe itself not more than half a dozen ports which could accommodate these vessels; and Liverpool alone, so far as we recall, is the only port which is the home port for more than a single one of these great transatlantic steamer lines. The reason is, of course, that the transatlantic passage to and from New York is the only steamship route in the world with a sufficient number of first-class passengers willing to pay high rates for passage to make the operation of such huge vessels a paying proposition.

These few huge ships of 40,000 tons and upwards, therefore, marvelous achievements of marine engineering though they are, should not be considered as by any means typical of current practice or current tendencies in the world's shipping trade. That there is a steady increase in the size of vessels is, of course, true, but the bulk of the world's commerce, passenger as well as freight, is still transported in ships averaging probably not over 5000 tons rating. Even on the main shipping routes to Africa and Asia and Australian ports which have the heaviest traffic, including a good proportion of first-class passengers as well as freight, the new ships are seldom over 10,000 to 12,000 tons.

Besides the traffic conditions the size of ships on most ocean routes is still limited by the available depth of water in the ports. In a great proportion of the ports of South America, Asia and Africa, the channels are too shallow to accommodate vessels of any greater draft than the vessels now using them without serious increase in the risk of damage by grounding. That this danger is not so very remote even in the unexcelled harbor of New York is evident from the letter by the Chief Engineer of the New Jersey Harbor Commission, on a following page. It appears that the west side of the lower Hudson, or North River, is only just deep enough to permit the maneuvering of vessels of 35- to 40-ft. draft and an immediate appropriation is needed to guarantee the dredging to a depth sufficient to insure against grounding. Apparently one very good reason why the "Vaterland" took four hours to do what the "Aquitania" did in twenty minutes was that the Hoboken shoal stops far short of the Manhattan shore.

Two Extremes in Paying for Highway Improvement

The State of New York is spending $100,000,000 to make improvements on 12,000 of a total of 80,000 miles of country roads. The cost of this work is paid for by a bond issue, for a very large proportion of which all the people of the state are, and will be for many years, taxed equally, at least in theory. The farmer who lives ten miles from an improved road pays as much as his more fortunate cousin whose farm borders the improved road, and who consequently has frequent opportunity to make use of it, and whose property may be enhanced in value because of its improved accessibility. The other chief beneficiary is the comparatively small percentage of people who own and have leisure to use motor vehicles.

On the other hand, the City of Cleveland, Ohio, is considering the repavement of a street called Main Ave., which work, according to regular procedure, will be paid for, to the extent of 98%, by assessments on the abutting property owners. This street is in a section of the city built up with humble homes; but it is a main thoroughfare to several large industrial plants, and hence an expensive pavement is required. The assessments for the pavement would amount to $12.60 per front foot. Many poor people may be required to pay nearly as much for this pavement as their lots are worth; and at least four-fifths of this expense is solely for the benefit of the heavy traffic using the street as a through route.

The New York State method of paying for public highway improvements is the more popular, for the majority of people do not feel this indirect method of assessment, and those who are directly benefited get more than they pay for. But the injustice of loading the cost of local improvements and temporary pavements upon all the people and upon future generations to come, equals the injustice of assessing property owners for the cost of an improvement which will be of no particular benefit to them.

Engineers as engineers are not particularly concerned as to the source of the funds placed at their disposal; but engineers as citizens and public-spirited men should be very much concerned to see that the public gets a fair deal in the matter of distributing first cost as well as in the execution of the work. It is a very large and complex problem and one not easily solved, but its equitable solution rests more upon the shoulders of engineers than upon members of other professions, for engineers only have extensive knowledge of many of the determining factors, and it is for them to use this knowledge for the public good.

The Disappearing Profit in Railway Passenger Service

The railway president who, many years ago, said that he had rather carry hogs than commuters intended no disrespect to a worthy class of the traveling public; nor had he any reference whatever, it is believed, to the bedding of peanut shucks and newspapers with which the floor of passenger cars is occasionally carpeted; nor did he refer to the undeniable porcine traits easily discoverable in occasional travelers. What he meant, undoubtedly, was that since a railway is run, ostensibly at least, to earn dividends for the stockholders who own it (or think they own it), he preferred to carry the traffic which yielded the largest profit.

Notwithstanding all that has been done in the direction of crowding the largest number of passengers in the smallest possible space, and notwithstanding the noticeable resemblance between the passenger trains and the stock trains on some roads, it still remains true that the transportation of hogs yields an excellent profit while the profit from carrying commuters is mostly of the minus order.

The reason for this is exceedingly simple. A hog travels when the railway pleases, but the railway has to carry the commuter when the commuter pleases. Ninety-five per cent. of all commuters (generally from circumstances beyond their own control) travel cityward between the hours of seven and nine a.m. and [illegible] homeward again, in an even more concentrated [illegible], between the hours of five and six in the afternoon. Woe betide the luckless railroad official who fails to [illegible] for the swarming throng of commuters, trains [illegible] to the minute to carry them when they appear. [illegible] were it for that railway official had he stayed at the bottom of the ladder and never been promoted to the position of authority. It is entirely possible that the exacting character of the commuter as a patron had something to do with the remark of the railway President which we have quoted above. The railway company which is blessed with a heavy commutation traffic, therefore, has to provide rolling stock and tracks and train crews sufficient to carry the rush-hour traffic and during about 20 out of every 24 hours this equipment and staff have nothing to do. There are other reasons also, such as the expensive property usually required for suburban passenger terminals, which account for the generally unprofitable nature of commutation traffic.

The serious situation that confronts a large proportion of American railways at the present time, however, is that not merely commutation traffic but passenger traffic as a whole has ceased to pay any considerable profit.

A remarkable statement upon this point has recently been made by Louis Brandeis in his argument before the Interstate Commerce Commission. It is especially convincing because Mr. Brandeis has been for years past a leader of the forces which have stood in opposition to the railways' plea for permission to increase their rates. Mr. Brandeis, in fact, gained his greatest notoriety by his famous remark that the railways were losing a million dollars a day in operating expenses by not adopting "scientific management." Since he made that remarkable statement, Mr. Brandeis has evidently given a large amount of study to the facts concerning railway operation.

As special counsel for the Interstate Commerce Commission, he has taken a prominent part in the present proceedings before the Commission in connection with the petition of the railways east of Chicago for a 5% advance in their freight rates. Mr. Brandeis will certainly not be accused, therefore, of unduly favoring the railways in his statements.

In the address above referred to, Mr. Brandeis compared for several important railway companies the operating expenses in connection with passenger traffic and the receipts therefrom. On the Baltimore & Ohio railway system in the year ending June 30, 1911, the operating expenses in connection with passenger traffic were 82.39% of the passenger earnings. Two years later, in the year ending June 30, 1913, the passenger expenses were 106.23% of the passenger earnings; that is to say, the entire passenger traffic of the Baltimore & Ohio in that year not only paid no return whatever to the stockholders and bondholders of the Baltimore & Ohio, but actually cost the railway company more to carry it than the total receipts from passengers.

A still more convincing statement is furnished by the Pennsylvania R.R. because of its much greater prominence as a passenger road than the B. & O. According to Mr. Brandeis, the cost of handling passenger traffic on the Pennsylvania system in 1907 was 74.4% of the passenger earnings. In 1913, six years later, this oper-

ating cost had grown to 92.6% of the passenger earnings. This was not due, moreover, to a falling off in earnings, for the earnings actually increased during the four years from $31,000,000 to $38,000,000; but it was because the operating expenses increased much faster than the growth in passenger traffic. The Pennsylvania's net earnings from passenger traffic in 1907 were over $8,000,000, and in 1913 they were less than $3,000,000. Mr. Brandeis quotes with approval figures submitted for the Pennsylvania system showing that in 1911 the system was only earning an income of one-third of 1% on the capital it had invested in carrying on the passenger business. Since that time conditions have undoubtedly grown worse instead of better.

It would be easy, of course, to show the same facts in still greater detail by the official statistics of the Interstate Commerce Commission; but the significant fact to the public is that these figures are vouched for by Mr. Brandeis, who has made his chief reputation as a baiter of the railways. Their substantial accuracy, therefore, cannot possibly be gainsaid.

It ought to be emphasized in this connection that the chief reason why passenger traffic has become unremunerative is the increase in the cost of carrying it on and not reduction in passenger fares.

There has, it is true, been a slight reduction in the average passenger fare during the past quarter century; but while on a few roads the reduction has been considerable, the average throughout the United States, as shown by the Interstate Commerce Commission's statistics, is exceedingly small. During the last two or three years, moreover, during which passenger profits have fallen off so excessively, there has been very little change in passenger rates.

The chief reason for the loss of profits during the past three or four years, therefore, must be sought in the increased operating cost due to the forcing up of railway wages and the increased expenses due to various classes of legislation, both State and Federal. Officials of the Pennsylvania R.R. state that the recent laws relating to hours of service, boiler inspection, and full crews for train operation have increased the operating expenses of the Pennsylvania R.R. by two and three-quarter million dollars a year.

It must frankly be admitted, too, that the railways themselves have for years been steadily increasing the luxury of passenger travel with little regard to whether the profits from passenger traffic justified the change. We have recently commented editorially upon the enormous investment in costly passenger terminals, which began with the larger cities and is spreading all over the country. The introduction of steel cars with their greater dead weight means a large increase in operating expenses. The electric car-lighting system must be regarded as a luxury rather than a necessity in view of the very satisfactory light furnished by gas. In very many cases, too, an increase in train service is made to suit the progressive ideas of the passenger traffic manager with little regard to whether the volume of traffic to be handled justifies the increase. The luxuriousness of travel is not confined to the railways, moreover, as witness the ornate and sumptuous steamships, each surpassing in that respect its immediate predecessor.

It is of interest to recall that eighty years ago when the railway era began, the railway was chiefly looked upon as a passenger carrier and not a freight carrier. This was particularly the case in England where railways were built as competitors of the stage coaches on account of the high speed of travel which they made possible. It was not supposed for many years that the railway could possibly compete with the canal as a means of transporting heavy freight.

The most puzzling question of all is to know what the railways can do to remedy the situation in which they find themselves. Mr. Brandeis apparently thinks that the railways ought to increase their passenger rates instead of their freight rates and this position is not without reason where it can be shown that the freight business is yielding a fair profit and the passenger business is unremunerative. The practical difficulty with such a solution, however, is that any increase in passenger fares promptly operates to restrict travel and may, therefore, reduce instead of increase the net earnings. Moreover, in a good share of the States two-cent-a-mile laws stand in the way of any increase in passenger fares by the railways; and even though it were proved beyond the shadow of a doubt that it costs the railways more than this amount to carry their passengers, it would still be a political impossibility to secure the repeal of these laws. It may be said that the railways should cut down expenses by taking away some of the luxurious accessories in connection with passenger traffic. Here again, however, difficulty is met. The traveling public, having been educated to certain standards as representing what they may reasonably expect in railway service, will not put up with anything poorer without raising a strong protest; and these are times when railways especially need to cultivate the good will of the public.

It becomes increasingly evident that in one respect, at least, American railways are suffering from their failure to profit by European railway experience. The one-class system of handling traffic, universal on American railways (if we except the Pullman service and the "Jim Crow" cars of the South) is doubtless democratic and has also certain practical advantages in economic operation. On the other hand, the European system of taxing different classes of travelers according to what they are willing to pay has possibilities which deserve the study of American managers. Something of a beginning has indeed been made on some of the trunk lines in this country by charging an extra fare on the fast through trains. It is possible that by running special low-priced trains at certain hours of the day to accommodate that class of passengers to whom the saving of a few cents means a great deal it would be possible to make a moderate increase in the regular fares of passengers carried in first-class coaches by reason of the better accommodation they would thereby secure.

It is understood that any limitation in passenger service will arouse more immediate and intense public concern than will a similar limitation in freight service, because the former is directly before the mind and eyes of the average citizen, whereas the latter affects his pocket book only indirectly, but certainlw every means ought to be adopted by which the relation between operating expenses and earnings in railway passenger traffic can be brought back to a normal basis; and all extravagances in passenger service which have been allowed to develop during the last few years and which can be cut off should be.

Letters to the Editor

Electric Heat in Public School Buildings

Sir—In your issue of Apr. 2, 1914, was a brief note about the electrically heated public school building in Rupert, Idaho. Your note was in error in stating that it was the first electrically heated public school, that distinction belonging to a similar structure in this town. The Mountain Home school building has been heated by electricity for two years and was, until the building of the Rupert school, the largest building in the world so heated. Electricity is in general use about the building, although the system is not so complete as that used in the new building at Rupert.

CHARLES A. HACKNEY,
Editor, *The Elmore Times.*

Mountain Home, Idaho, May 28, 1914.

Shore Protection on Steeply Sloping Foreshores

Sir—Your various recent articles on foreshore protection and the destruction of shore-protection structures by heavy storms have been read with interest. You judiciously attribute the wrecking of the Octagon Hotel at Seabright, N. J., to the fact that it was only about 50 ft. back from the shore pile bulkhead, which could not stand the stress and strain of heavy storms with their tremendous waves beating down. According to Chamberlain and Salisbury, Geology, Vol. 1, p. 329, "Winter breakers which exert a pressure of 3 tons per sq.ft. are not infrequent. The average force of the waves on the Atlantic coast of Britain has been found to be 2086 lb per sq.ft. during the winter." Could any pile bulkhead, even with a protected foreshore in front in the sea, ever stand such a stress and strain of heavy storms? In this connection I would like to call attention to certain similar conditions existing at Sea Gate, on Coney Island, just outside of New York harbor.

Low groins and pile bulkheads extending from the Sea Gate bath house to the boat landing were completed in 1911. In 1912, much damage was done to both during the winter. In December, 1913, and January, 1914, you reported the damage done at a point opposite the lighthouse, where two arches of land have been submerged.

The prevailing conditions at Sea Gate are as follows:

(1) The slope of the shore is relatively steep, and the line of pile bulkhead is located about 25 ft. beyond the normal equinoctial high-tide mark.

(2) Several houses are built only 20 or 25 ft. back from the shore bulkhead; that is, practically on Neptunes domain.

(3) Low groins are built according to the rules, at right angle with the bulkhead, extending from same to low-water mark. Every winter, some of these groins have either seriously been damaged or even wrecked, so that at least in this particular instance their efficiency has not been proved.

Low groins have given satisfactory results at many European coast resorts of the Atlantic Ocean where a "gentle slope" prevails, but unfortunately the slope at Sea Gate, Seabright, and many other coast resorts in the United States is, I believe, too steep to insure the good working of low groins; or at least at Sea Gate they do not appear to check the lateral and litoral strong currents and those of ebb and flood tide so as to induce the undercurrents to work up material toward the shore. In fact, at the end of the stormy season, they are emerging several feet above the sand, considerably more on one side than on the other, and, since these groins and the pile bulkhead were completed, the sand accumulates at the point of the island where the boat landing necessitates periodical dredgings for the Sea Gate boat.

(4) The pile bulkhead and the low groins were damaged more or less every year during the stormy season. In January, 1914 they were wrecked. Under these circumstances, I question the advisability of building up over again the low groins and pile bulkheads.

In my opinion, the slope of the beach is so steep that it interferes with the efficiency of the low groins, and the bulkhead being about 25 ft. beyond the highest normal tidewater mark, some other method of protection should be resorted to, in order to check the encroachment of the ocean.

CHARLES MARCHAND.

1073 E. Davis St., Portland, Ore.

Need for Additional Dredging on the New Jersey Side of the Lower Hudson River

Sir—The difficulty experienced in docking and undocking the S.S. "Vaterland" on her maiden trip to New York Harbor has emphasized the necessity for additional dredging to remove the shoal which now exists on the New Jersey side of the Hudson River below the steamship terminals of the Hamburg-American Line, The North German Lloyd, and the Holland-America Line at Hoboken.

With the increasing depth of the large steamships more and more they have been compelled to use the deep water on the New York side of the Hudson, and instead of having an available width of river of 3500 ft. in which to approach the principal steamship terminals, both on the New York and New Jersey sides, the width is restricted at some points to not more than 1700 ft. on account of the shoal on the New Jersey side opposite Lower Manhattan.

This, for ships docking on the New York side, adds to the difficulties and dangers of maneuvering, particularly when unloading on a strong ebb tide; they will then drift down the river while being turned and must be

kept on the New York side to prevent their being carried by the current on to the shoal on the New Jersey side.

The ships docking in Hoboken experience greater difficulty than those docking in New York, particularly when approaching their piers on an ebb tide. The shoal water is directly downstream from their piers and extends far out into the river so that the ships must approach in the channel on the New York side until almost opposite the piers and then turn, and great skill must be exercised lest the ebb tide carry the ships against the piers with undue force which might inflict damage to the piers as well as to the ships.

The Federal authorities on recommendation of the New York Harbor Line Board in 1913, appropriated $52,600 to remove the shoal from in front of the New Jersey steamship terminals, and this work was carried out in time to permit the S.S. "Imperator" to dock in 40 ft. of water on her maiden trip.

The dredging done at this time was mostly directly outshore of the steamship terminals, although an approach downstream was provided on an angle of about 45° with the river, from the southerly pier of the Hamburg-American Line. There remains of the original appropriation of $52,600 an unexpended balance of about $20,000.

It is probably a fact that the docking of the S. S. "Vaterland" on May 21, 1914, was interfered with by a small craft near her pier, but if she could have approached her pier closer to the New Jersey side (there being at the time a strong ebb tide) so that when she came opposite her pier she would have been headed more nearly upstream, she would have been less likely to have lost her position in avoiding the interfering craft. As it was, and as noted in ENGINEERING NEWS, May 28, she was compelled to maneuver for nearly four hours, many times dangerously near the shoal water on the New Jersey side, and pretty thoroughly disorganized harbor traffic. This shoal water was probably responsible to a considerable extent for the trouble experienced when this ship left her dock on May 26, as also noted in your issue of May 28. An ebb tide was running, and it was necessary for her rapidly to back out into the deep water on the New York shore, while being straightened downstream in order to avoid the shoal on the New Jersey side.

The New Jersey Harbor Commission and the officers of the Hamburg-American Line have urged upon the Federal authorities the necessity of extending the 40-ft. depth of water in the river farther downstream, to make a better approach to the steamship terminals in Hoboken. For immediate relief an amendment to the Rivers and Harbors Bill, which is about to be reported, will be introduced in the Senate permitting the unexpended balance of about $20,000, referred to above, to be used for this purpose. A project for removing the shoal to a depth of 30 ft. in front of the New Jersey pierhead line in Jersey City and Hoboken has been approved and money appropriated, but in such a river as the Lower Hudson, carrying probably a greater tonnage than any other river in the world, and carrying the finest and largest steamships of all the great companies in the transatlantic trade, there should be ample depth over its entire width to accommodate any ship coming to this harbor.

For many years there has been a demand on the Federal government for the removal of this shoal, but with the exception of the recent appropriation for dredging out shore of the steamship terminals in Hoboken, there does not appear to have been expended in dredging by the Federal government, more than $25,000 altogether.

The necessity for the regulations of harbor traffic to such an extent as to prevent undue interference with the docking of the larger ships has been recognized by the Federal authorities, and legislation to permit this has been applied for.

B. F. CRESSON, JR.,
Chief Engineer, New Jersey Harbor Commission.
75 Montgomery St., Jersey City, N. J.,
June 8, 1914.

Notes from Engineering Schools

SYRACUSE UNIVERSITY—The Board of Trustees of The New York State College of Forestry have just announced plans for the establishment of a course in paper and pulp making. There are 18 paper mills within 20 miles of Syracuse and the Oswego and Black River districts are easily accessible so that practical demonstration can easily be secured. Also, the pulp timber areas of the Adirondacks are within a few hours' ride.

The proposed course covers three lines of study: (1) mechanical; (2) chemical; (3) forestry. The paper-making machinery is heavy, expensive and special; men versed in mechanical engineering as well as forestry and paper making are reported needed for this side of the industry.

HARVARD UNIVERSITY—The Graduate School of Business Administration during the past year has conducted a tentative course in fire-protection. The objects have been officially stated as below

(1) To give the student the fundamental features of construction, protection and fire-prevention equipment, and of the materials and processes that constitute hazards, and the proper treatment of same to enable him to become a fire-insurance engineer or insurance rate maker.

(2) To furnish men who may become the owners or managers of buildings or business plants with such a knowledge of the fire hazard as shall enable them to intelligently safeguard their property, and to work out such conditions of construction equipment and process as will result in a lessening of the liability to fire, and a consequent reduction in rate of fire insurance.

(3) To give such a knowledge of what may be done by way of lessening the liability to fire, and effect such a saving in the cost of insurance as will enable the student, should he become a fire-insurance broker or agent, to advise his customers with intelligence on those points that make for the safeguarding of their property and the reduction of their outlay for fire-insurance protection.

Special lectures were delivered by about a dozen fire-prevention engineers, between Jan. 28, and Apr. 1. In April, the students visited the laboratory of the Underwriters' Bureau of New England on six days where tests of sprinkler heads, oil flash points, valve adjustment, hydrant flow, etc., were demonstrated. In May, the men were given five field days with the Bureau's inspectors for the study of selected insured properties (mercantile, manufacturing and public-utility). Four days will be spent with inspectors of the Boston Board of Underwriters in annual surveying and scheduling of rates.

An Analysis of Highway Improvement Work in Illinois; New Organization*

Investigation shows that the people of Illinois are spending on country roads approximately $7,000,000 annually, probably not less than $50,000,000 in the last ten years. And yet with all this expenditure less than 10% of our roads are improved with gravel, macadam, concrete and brick, and probably less than 30% additional are thoroughly dragged. Without doubt 40 to 50% of the money has been expended in temporary work that has brought no lasting benefit.

It is estimated that about $2,500,000 annually has been paid for the construction of bridges and culverts. Many of the bridges were built of steel when concrete could have been used with but very little, if any, additional cost.

Not less than $2,000,000 to $2,500,000 annually has been expended on our earth roads. Some part of this has been used in reducing grades and is along permanent lines, also a part has been used for dragging; but when we consider that so small a percentage of our roads have been well dragged and that $20 per mile annually is ample to keep a road well dragged, it must be acknowledged that much of this $2,000,000 to $2,500,000 has been expended in work that failed to give value received to the public.

Much money has been paid out annually for tools and machinery, averaging probably not less than $500,000. Part of this machinery has proven efficient and has been bought at reasonable prices, while a considerable part has been found totally unadapted to the work for which intended, and another part purchased entirely too high.

The cause for this situation lies primarily with the people who, up to the time of the last legislature, had been content to continue the old system, giving the highway commissioners no technical or engineering assistance and leaving them to depend upon the advice of the salesman, who was interested in selling his particular line of machinery, culvert pipe or bridges. The people have now come to realize that bridge building and road building, whether it be in the construction of a hard surfaced road or a properly drained earth road, requires men of training and experience; further, that we cannot have effective work without a definite plan and authority to carry it out.

Accordingly the Tice law (passed in 1913) provided for the appointment by the Board of Supervisors of a County Superintendent of Highways, a part of whose duty it is to advise and assist the Township Highway Commissioner in carrying on his work. He has the approval of all contracts made by the highway Commissioner in excess of $200 which carries with it the supervision of the work for which the money is expended. If a bridge is to be built for which the county pays any part of the cost, the Country Superintendent of Highways prepares the plans and specifications under the approval of the State Highway Commission. If a bridge is to be constructed at the expense of the township alone and the cost exceeds $200, it must be of such type and specifications as will meet with his approval and he must supervise the construction.

The County Superintendent should be called upon by the Highway Commissioner to make surveys for the drainage work, including the proper level for culverts and should also furnish specifications for, and assume the supervision of culverts. In the purchase of machinery, his advice should be valuable both as to efficiency and cost. It is made his duty to make surveys, plans and specifications for any road improvement carried on under the hard roads section of the law. Beyond these specific duties he is subject to the call of either the Highway Commissioner or the county board for any assistance.

*Extracts from an article in "Illinois Highways" for May, 1914, the official bulletin of the State Highway Department, by S. E. Bradt, Secretary of the Illinois Highway Commission.

Waterproofing A Concrete Reservoir

The following particulars of the waterproofing of a circular concrete reservoir will interest many engineers. The reservoir is 142 ft. in diameter, 32 ft. deep at the wall and 37 ft. deep at the center. About 66% of its height is above ground. The engineer recommended the use of forms built up as the work progressed, so that the concrete could be thoroughly spaded, but as the contractor was under bond to make the reservoir water-tight, the engineer did not have authority to control all the methods of construction. The forms were built to about half the height before concreting was commenced, and were then extended to full height while the concrete was being poured. The concrete was delivered in place by spouting, the contractor relying on the wetness of the mixture to get a dense and water-tight concrete. The pouring, once started, was continued day and night until completed. To increase the density, a waterproofing compound was mixed in the concrete, but this did not work well under the conditions, and when the concrete was spouted into place, it caused a foam or lather which rose to the surface in the forms. Large lumps of this were found containing no sand or stone.

When the forms were stripped, it was found that this lather had resulted in streaks and spots of a spongy substance, some of these being of considerable size. The contractor (who was thoroughly conscientious and had done his misguided best to secure good results) proceeded to dig out the soft spots and to replace the spongy material with concrete. The subsequent leakage through the walls was not very great, but leakage through defective concrete in the bottom caused some anxiety, as likely to affect the foundations.

To make the reservoir water-tight, a coal-tar pitch coating on the original concrete was proposed by the contractor. This was not accepted, however, as it was thought that it would not be permanent and was sure to be injured by periodical cleaning of the reservoir with wire brushes for the removal of algae.

The plan finally decided upon was to cover the floor and sides of the reservoir with a membrane of felt and hot mixture of coal-tar pitch and asphalt, and then to cover this with a 4- or 6-in. protective lining of reinforced concrete. This work has now been carried out successfully. Two very small leaks showed at first, one at a ladder bolt and one where the overflow pipe passes through the wall. The first leak has entirely disappeared, and the leakage along the overflow pipe has diminished to only about three or four drops per minute. As the reservoir appears to be otherwise absolutely water-tight, it has been accepted by the municipal authorities.

The Cunard Liner "Aquitania"

The steamship "Aquitania" of the Cunard line, which ranks with the "Imperator" as the second largest vessel in the world, reached New York on her maiden voyage on June 5. The initial arrival within a month of two such enormous steamers as the "Vaterland,"* the largest in the world, and the "Aquitania" draws attention anew to the preeminence of New York City as a world port and to the extreme conditions which such ships impose on the design and construction of the harbor.

The "Aquitania" was built by the Cunard Steamship Co. to supplement the express service of the "Lusitania" and the "Mauretania," which at the time of their construction in 1907 were the largest ships in the world and which still hold the palm for speed in the transatlantic voyage. The newer and larger vessel, however, was not designed to make the speed of the older ones and did not get a government subsidy. It is, however, considerably larger than either of its companions. The "Lusitania" for instance is arranged for a total population of 3000, whereas the "Aquitania," some 115 ft. longer, will take care of a population of 4200.

The "Lusitania" and "Mauretania" were subsidized by the government on the condition that they could maintain a minimum average ocean speed of 24½ knots in moderate weather, which speed they have consistently maintained, and during good weather both have been able to maintain a speed of 26 knots. The "Aquitania," on the other hand, is designed for an ocean speed of 23 knots, which will enable her to cross in five and one-half days. Her trial-trip speed was 24 knots. The effect of the difference of speed upon the engine requirements is suggested by the fact that while the 26 knots of the "Lusitania" required 158,350 sq.ft. of heating surface in the boilers, the 24 knots of the larger "Aquitania" only require 138,595 sq.ft. and the weight of the machinery is 10% less in the larger vessel.

We give herewith a table taken from London *Engineering* of May 15, 1914, showing the dimensions of the largest ships in the world, all of which ply the transatlantic route between Europe and New York. Some few dimensions are missing, notably the draft of the "Vaterland" but the figures are sufficiently complete to show for what sizes the modern ports have to be designed. While it is quite probable that only New York in this country will have to provide accommodations for such vessels, it is nevertheless a fact that numerous other ports in designing for the far future will arrange their dimensions to suit the possible future as expressed by the figures given in the table.

Accompanying the table there are some interesting facts given in the article in our English contemporary which are abstracted below.

There are always difficulties in making comparisons of steamships because the length overall may be influenced by features which are scarcely essential to the structure of the ship, while the length between perpendiculars is more or less arbitrarily fixed, as the perpendicular point may vary with the idiosyncrasy of the designer. Again, as regards gross tonnage, this may be affected by the coefficient of fineness of the ship. As regards displacement tonnage the question to be determined is as to whether the draft to be taken into account is in the loaded or unloaded condition or the mean draft on the voyage, or the draft at the beginning or end of the voyage. These limitations should be carefully borne in mind in any comparison that may be made of the dimensions as set out in tabular form.

It will be seen that the "Aquitania" has a length overall—and in this no excrescences are included—of 901 ft. 6 in. The "Britannic" (which was launched on Feb. 26) is 882 ft. 9 in.; the "Imperator" is 905 ft.; the "Vaterland" is 927 ft. 6 in. The gross tonnage of the "Aquitania" is 47,000 tons; of the "Britannic," 48,000; of the "Imperator," 52,117, and of the "Vaterland," 53,500. The German ships are obviously intended to be faster as the machinery is of much greater power. Thus while the "Aquitania" has a designed power of 60,000 shaft-hp. and the "Britannic" of 50,000 hp., the "Imperator" has to develop 76,270 hp., and the "Vaterland" a still greater amount.

The "Aquitania" is on what may be termed the triple-expansion system, namely, three turbines in series. The high-pressure turbine exhausting into the intermediate high-pressure turbine, which latter passes steam to the two low-pressure turbines mounted on the inboard shaft, while on the wing shaft there are high-pressure astern turbines and on the inboard shaft low-pressure astern turbines each of great power.

The hull of the "Aquitania" is divided into 84 compartments in addition to the 41 embraced in the double bottom, which extends right fore and aft. There are 16 transverse bulkheads, most of which extend to 19 ft. above the load water-line, and a few others to 9 ft. above the load water-line. There is a fore-and-aft bulkhead on each side of the space occupied by the boilers, so that in this part there is practically a ship within a ship.

The "Aquitania's" maiden trip was made in 5 days, 17 hr., 43 min., at an average speed of 23.1 knots. In marked contrast to the 4 hr. required to dock the "Vaterland," the "Aquitania" was docked in 21 min.

*The "Vaterland" berthed for the first time May 14.

TABLE SHOWING DIMENSIONS OF LARGEST TRANSLANTIC STEAMSHIPS

Name of ship.....	"Vaterland"	"Imperator"	"Aquitania"	"Britannic"	"Olympic"	"Lusitania"*	"La France"
Name of builders....	Blohm & Voss, Hamburg	Vulcan Company, Hamburg	John Brown & Co., Clydebank	Harland & Wolff, Belfast	Harland & Wolff, Belfast	John Brown & Co., Clydebank	S. des Chantiers et Ateliers de St. Nazaire
Name of owning company.....	Hamburg-America	Hamburg-America	Cunard	White Star	White Star	Cunard	French
Year when built.....	1914	1912	1914	1914	1910	1907	1910
Length over all.....	927 ft. 6 in.	905 ft.	901 ft. 6 in.	882 ft. 9 in.	883 ft.	785 ft.	714 ft.
Length between perpendiculars.....	.....	880 ft.	865 ft.	850 ft.	.....	760 ft.	685 ft.
Breadth.....	100 ft.	98 ft.	97 ft.	93 ft. 6 in.	92 ft.	88 ft.	75 ft. 9 in.
Depth, molded.....	57.1 ft.	62 ft.	64 ft.	64 ft. 3 in.	64 ft. 3 in.	60 ft. 4½ in.	52 ft. 10 in.
Gross tonnage.....	53,500	52,117	46,500	48,000	45,000	32,000	24,448
Draft.....	.....	35 ft. 6 in.	36 ft.	34 ft. 7 in.	.....	33 ft. 6 in.	30 ft.
Displacement.....	.....	57,000 tons	53,000 tons	53,000 tons	.....	38,000 tons	27,000 tons
No. of passengers—first.....	.....	700	618	790	730	552	535
No. of passengers—second.....	.....	600	614	836	560	460	442
No. of passengers—third.....	.....	2690	1998	953	1200	1186	908
Machinery makers..	Blohm & Voss	Vulcan Company	John Brown & Co.	Harland & Wolff	Harland & Wolff	John Brown & Co. Clydebank	S. des Chantiers, St. Nazaire, etc.
Type of engine.....	Turbines	Four-screw steam-turbines	Four-screw steam-turbines	Reciprocating, with turbine on center shaft	Reciprocating, with turbine on center shaft	Parsons turbine	Four-screw steam-turbine
Total indicated hp...	.....	76,250	60,000	50,000	46,000	68,000	46,370
Speed on service....	.....	22½ knots	23.5 knots	.....	22½ knots	25 knots	23.6 knots
R.p.m.....	.....	185	155	77 and 170	77.5	180	241.5

*The Cunard liner "Mauretania" is practically of the same dimensions as the "Lusitania"; she was built by Messrs. Swan, Hunter & Wigham Richardson, Limited, Wallsend-on-Tyne, and engined by the Wallsend Slipway & Engineering Company, Limited.

Construction of the Largest Steel Gas Holder, Brooklyn, N. Y.*

By L. S. Stiles†

A gas holder 251 ft. in diameter and 275 ft. high, with a capacity for 10,000,000 cu.ft. of illuminating gas, was completed in 1910 for the Newtown Gas Co., Borough of Queens, New York City. This is claimed to be the largest steel-tank holder in the world. A modern gas-pumping station equipped with gas engines and a steam boiler for heating the seal water of the tank, was also erected at the site.

The finding of suitable ground for the erection of a large gas holder is not always a simple proposition. For the holder under consideration a plot of ground about 258x258 ft. is required. Furthermore, the ground selected should be at a comparatively low elevation, so that the holder will be as little of an eyesore as possible, and so that the most effective pressure may be maintained. Pressure conditions are just the reverse with a gas tank from those affecting the placing of a water tower.

The location of a large holder must be convenient to a railroad spur or a dock, or at least must be easily accessible to one of these points by means of a good wagon road. The construction of such a holder necessitates the transportation of about 5000 tons of structural material plus the construction outfit and the material needed in the foundation. The steel includes steel plates, $2\frac{5}{16}$ in. thick, and large castings which support the 42-in. inlet and outlet pipes, etc.

The site selected for the Newtown Gas Co.'s holder fulfills all these conditions very well; and the area of the property, about 5 acres, is sufficient for the erection of any auxiliaries required. Test borings show a good, compact, gravelly soil, well suited for a foundation, without any necessity for piling.

Description of the Holder

The holder consists of a reinforced-concrete foundation and base, a large water tank, a steel superstructure, five moving telescopic sections or lifts, and three 42-in. pipe connections.

The holder will never be filled to much more than 95% of its capacity, to allow room for the gas to expand under the influence of the temperature, and to prevent the holder seals from blowing. On a warm day it actually happens that the expansion taking place in the holder more than balances certain gas consumptions.

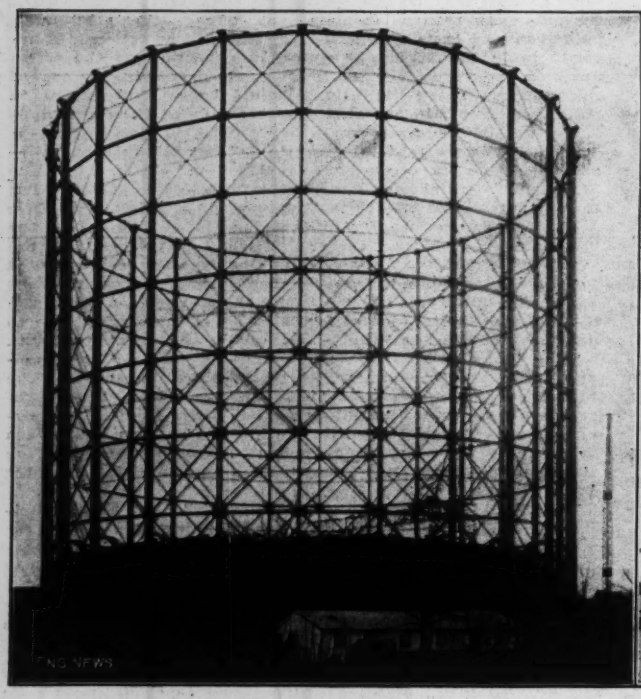


Fig. 1. Showing Steelwork

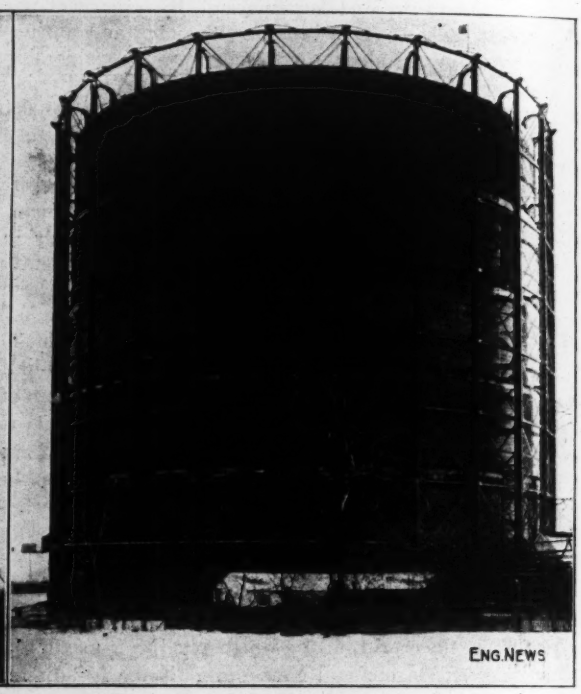


Fig. 2. The Holder Inflated

(The 10,000,000-cu.ft. Newtown gas holder completed.)

Reinforced-Concrete Base — The excavation amounted to 30,000 cu.yd. The concrete foundation is $1\frac{1}{2}$ ft. thick in the center and 3 ft. 9 in. at the rim. This latter thickness extends in 15 ft. 6 in. from the edge of the foundation, and is reinforced with $\frac{7}{8}$-in. square bars placed radially. The foundation contains about 6200 cu.yd. of concrete.

Water Tank—The necessity for a water tank in connection with a gas holder arises from the fact that the outer lift, or the first moving section (from the bottom), travels up and down 40 ft. or more, whereas the lowest unit of the holder—the tank—must be stationary. The lowest moving section must at all points of its travel dip into the water contained in the lowest unit; an immersion of its bottom edge of 14 to 15 in. is required if the holder is fully inflated, to avoid escape of gas. This fact

*Arranged from a paper presented before the Brooklyn Engineers' Club on May 14.

†Construction Engineer, Brooklyn Union Gas Co., 556 Kent Ave., Brooklyn, N. Y.

necessitates a column of water in the tank about 40 ft. high, which, however, could be formed by constructing another tank inside the outer one, with a space of about 12 ft. between the two; this space being filled with water, but the inside tank empty. Of course this inner tank would require a top.

The capacity of the tank is about 17,000,000 gal. Three weeks were required to fill the tank, with a 6-in. inlet. The value of the water contained is over $2000.

GAS TANK AND FRAMEWORK—The holder proper is constructed entirely of steel. The thickest plates, in the sides of the tank at the bottom, are $2\frac{5}{16}$ in. thick. The rivets in the bottom rims of the tank are $1\frac{3}{4}$ in. in diameter; the longest ones are $8\frac{7}{8}$ in. long. There are 5500 of these $1\frac{3}{4}$-in. rivets, and over six thousand $1\frac{5}{8}$-in. rivets. There are over two million rivets of varying sizes in the entire holder.

In order to allay all apprehension as to the strength developed by the riveted joints in the tank plating, special tests were undertaken on an experimental butt joint with inside and outside butt plates and three $1\frac{3}{4}$-in. rivets. Our conclusions were that the strength of these joints, properly designed, is not less than the strength of its elements and further that the frictional grip in such

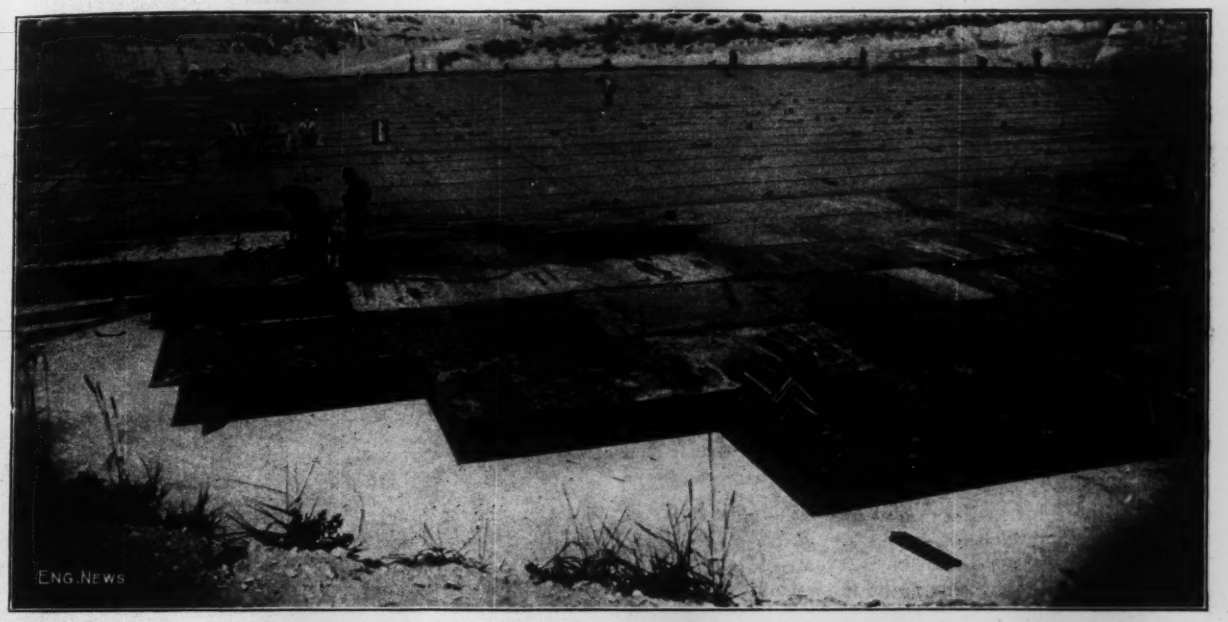


FIG. 3. RIVETING THE BOTTOM PLATES OF THE NEWTOWN GAS HOLDER

FIG. 4. LOWERING THE BOTTOM BY CONCERTED MOVEMENTS

a joint is so great that within the limits of the working stresses there is neither shear in the rivets nor bearing stress against the shank.

All the steel was tested at the mills and the shops, and inspected during erection; and all the cement used in the foundation was tested and inspected.

The extreme thickness of the lower tank plates indicates that the limit in the design of steel holder tanks is rapidly being approached.

FIG. 5. ERECTION TRAVELERS IN PLACE

(The two travelers are pivoted at the center of the tank and move on a circular one-rail track inside the holder. They place the steel and carry the 150-ton pneumatic riveter shown in Fig. 6.)

FIG. 6. THE 150-TON RIVETER WORKING ON INSIDE SECTION

CONSTRUCTION OF THE STEEL BOTTOM—After the concrete base of the holder was built, the bottom of the tank was constructed about 3 ft. above it, thus allowing room underneath to hold the rivet heads, etc. The bottom was temporarily supported in this position by wooden struts consisting of two boards each about 3 ft. long, nailed together at right angles, set with a level as required, and properly squared on top. A network of pipes was laid for compressed-air riveting.

The bottom is constructed of 5/8-in. and 3/8-in. plates, the outer rim, 8 ft. wide, being 5/8 in. thick. The bottom weighs about 400 tons complete. After the riveting was finished, the bottom was calked and tested for watertightness, and everything being found statisfactory was lowered to its final resting place on the foundation which was first covered with 2 in. of dry grout (one part cement, two parts sand). This dry grout conforms to the unevenness of the plating and causes an even distribution of pressure. Any sweating of the metal or small leaks caused by lowering set the grout; the leaks are stopped and the metal is protected against rust.

A few words on the method of lowering: equally spaced holes are provided in the plating and after the bottom is completed and tested, screw jacks are inserted in the holes and brought to rest on the concrete foundation. The nuts of the jacks are about 3 ft. above the plating and each is provided with two bars which run in a direction slanting to the plating and are bolted to lugs on the same. The two bars of each nut are in a vertical plane and the planes of successive jacks are turned 90° to each other, to steady the bottom while it is being lowered, and prevent swaying and possible careening of the bottom. There are some 180 jacks in all and each one is served by one man. All jacks are operated in unison to the stroke of a gong and the bottom is first raised clear of the supports which are then removed, and then it is lowered down to the foundation. The hand holes are afterwards covered with bolted plates after the jacks are withdrawn.

After the bottom is lowered into place, the work of building up the tank sides and the five lifts is started in rapid succession. The frame is first carried up to its full height and the five sections are built up simultaneously

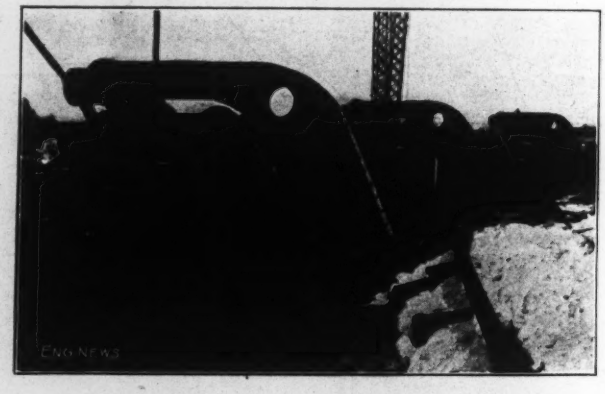


FIG. 7. A TOP VIEW, SHOWING SECTIONS COLLAPSED

in their landed positions, i. e., telescoped inside of the tank.

STEEL ERECTION AND FINAL INSPECTION—A track was constructed entirely around the holder, outside of the tank, for distributing the steel, and two travelers were erected which ran on a circular track inside the holder and were pivoted at its center. The travelers, which were high enough to clear the tank and all sections in their landed positions, lowered the plates into place as required and carried the large 150-ton pneumatic riveters. As far

as possible the construction work was carried on day and night.

The inside section is provided with a crowned top constructed on a permanent wooden frame which remains immersed in the water of the tank after it is filled, and serves to receive and support the crown any time that the holder is required to be landed.

Two flat-bottom boats were placed on this lake before the crown plating is finished and are kept there permanently. A manhole is provided in the crown.

When the holder is complete, it is inflated with air and the final inspection begins. The manhole cover on the top is taken off and a man with a lantern is lowered

FIG. 8. ONE OF THE THREE 42-IN. PIPE CONNECTIONS

through the outrushing air into the holder, in order to adjust the interior rollers. Any leaky seams or rivets are calked and then the holder is painted. The first coat is applied during the inflation of the holder.

The tank is surrounded by a concrete wall whose outside is coated with two coats of roofing pitch as an extra precaution to preserve the steel from rusting when the surrounding ground is graded up.

GUIDE ROLLERS—The moving sections are guided in their travel up and down in the following way: Opposite each vertical guide post (26 of which, all properly braced and stayed, encircle the holder), each lift is provided with a system of guide rollers supported on carriages. There are two rollers 12 in. in diameter, keyed to horizontal shafts which revolve in bearings situated at the top of the lift. The rollers press against the flanges of a 9-in. I-beam (Detail *B*, Fig. 9), which forms the guide post and keep the lift from revolving around its vertical axis. These are called tangential rollers. A third roller with a horizontal axis, projects out from the lift at the same place and presses against the web of the 9-in. I-beam. This is the radial roller and prevents the lift from swaying. Of course, when the holder is inflated, it is also necessary to guide the bottom edge, and for this purpose a fourth roller (Detail *C*, Fig. 9) is provided at the bottom of the lift, of a type similar to the radial roller just described. It presses against a 6-in. channel bar secured to the inside of the lift.

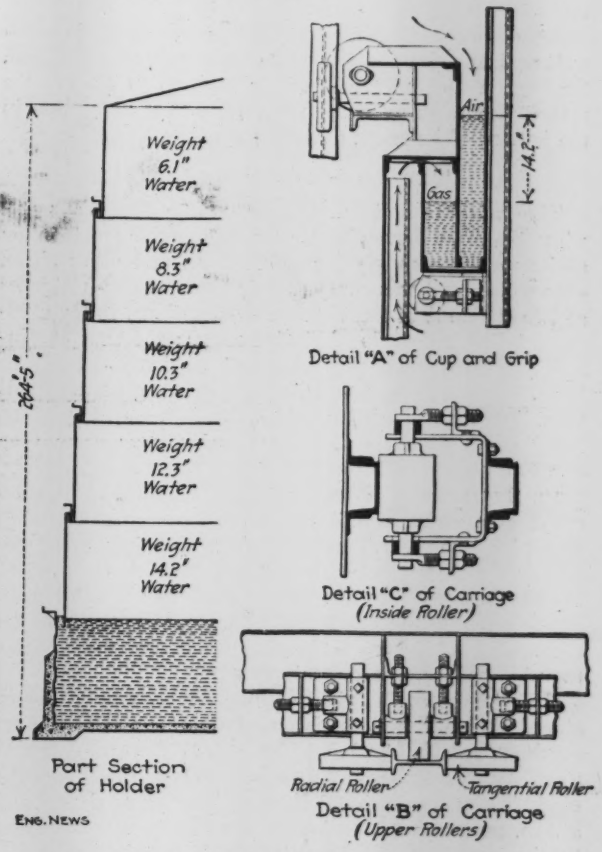


FIG. 9. SHOWING GUIDE-ROLLER SYSTEM FOR MOVING SECTIONS

PIPE CONNECTIONS—Gas is admitted or withdrawn by means of three 42-in. pipe connections, distributed around the circumference of the holder and placed where they will be most convenient. Each 42-in. pipe is located in a tunnel built in the foundation of the holder and is so supported that any settlement of the foundation, however improbable, would not affect the pipe. Where the pipe enters the tank a special casting is provided which forms a support for that portion of the pipe which rises through and projects above the water of the tank.

Two of these three connections are carried to the gas pumping station which was constructed close by and which serves to pump the gas to and from the holder as required. All the lead joints in the pipe were calked with lead wool by compressed air.

Air-Valves on Water-Supply Mains

By Clemens Herschel*

The primordial air-valve, as found on cast-iron pipe mains, was and yet is, ordinarily, not much different from a petcock, placed on a grade summit. When air accumulates at the summit, some pipe walker once in a while opens the valve to let out the compressed air; and should the pipe empty itself by reason of a slab of it coming out, or otherwise—or if the water be drawn out—somehow or other, air manages to replace the water discharged, and nobody is much the wiser why an air-valve was ever placed on the summit.

Sometimes such air-valves have been made to open automatically, by the use of an inverted cup, or a ball, floating on the water, when it is not pressed against the seat of the valve by water pressure, or has not fallen to the bottom of its range of motion.

The East Jersey Pipe Line

This was the state of the art twenty-five years ago, when the East Jersey Water Co. began the construction of its works to supply Newark, N. J., and other cities, with water, and was compelled by force of circumstances and to enable it to meet contract obligations, to lay a 23-mile, 4-ft. pipe, made of riveted metal; the first continuously riveted water pipe built east of the Rocky Mountains. It was recognized at once by the engineers of this pipe line that air-valves had a much more important function on a collapsible pipe line like this, than they ever had had on cast-iron pipe mains.†

In Engineering News, of July 27, 1911, is an account of a series of failures, by collapsing, of the Bull Run pipe line, near Portland, Ore. The account of the same is so mixed up with a description of the tests of the pipe against bursting, that it requires a careful reading to separate the one from the other. In one case the pipe collapsed during a drawing off of the water, after the pipe had been tested for pressure.

This was a 52-in. pipe, calling for an ample size of air-valves, but complaint is made of single air-valves having been specified to have 12.5 sq.in. of opening, which when built had only 7.5 sq.in. When the hydraulic grade line came within 30 ft. of the surface of the ground a 3-in. pipe and hand-valve at the top, could, according to the specifications, be substituted for the automatic valves otherwise prescribed. No indication exists that any computation of the necessary size of the air-valves was ever thought of. The ditch was only partly filled in, but under the circumstances that had little to do with what happened. Let it pass as a horrible example.

The twenty-five year old, pioneer continuous riveted pipe line of the East Jersey Water Co. has been spoken of, but the builders knew what was required of them in the line of air-valves.

This is the 48-in. pipe line intended to convey 50,000,000 gal. daily, but which, when finished, would carry only about 43,000,000 gal., due to reliance placed on a false statement of the carrying capacity of a 36-in. pipe (then the next largest pretendedly gaged pipe line in existence) made in a public document; all as related in the book called "115 Experiments"; John Wiley & Son, publishers.

This is what is said* concerning a comparison to be made between cast-iron and riveted-steel conduits:

> Against the advantages of more trustwortniness, less cost, and less time required to construct, could only be put the fact, that a steel pipe will float, and will collapse, under circumstances which do not similarly affect a cast-iron pipe; whence the necesity of guarding against such mishaps in the case of the riveted pipe by the proper designs and appliances.

And on p. 8, is found an account of what this pipe underwent in the line of practical operating tests when first put into use:

> The first winter the pipe was empty, and thermometrical records show that the inside temperature went slightly below 32° F. on several occasions. The second winter much worse than this took place, and worse than is ever likely to happen again. The pipe line being completed Dec. 31, the rest of the winter was spent in testing the pipe, and remedying defects thus discovered; an operation that involved a repeated filling and emptying of the pipe. This was done during the best available weather, but in spite of all care taken, the pipe must frequently have been filled with air of a temperature below 32° F., then filled again with water of 32° temperature; portions of it stood empty, or with still water in them, during severely cold weather, and so on. No effect has ever been observed as resulting from this treatment of the pipe line.

On p. 12, the air-valves are specifically described:

> AIR VALVES—The office of automatic air-valves on a steel or wrought-iron pipe line is to let the air out of the pipe when it is being filled with water; to let the air into it again when the pipe is drawn; also, to let air into the pipe, and thus prevent the collapse of a long stretch of pipe, should, by any accident, such as a breakage of a blowoff connection, or of the pipe itself, a large quantity of water suddenly flow out of the pipe. To this has been added in the same casting an ordinary valve, by means of which accumulated air may be let out of the pipe while it is in operation. The basis of the automatic air-valves is a brass cup, 2¼ in. in outside diameter, and 4 in. high, turned bottom up, and light enough to float on water. The upturned bottom forms the valve disk, which is made to set up against the valve seat, when the cup, floating up between brass guides, and after the air contained in the pipe has been blown out, is reached by the rising water. The air imprisoned within the cup forms an air cushion for this upward thrust. When the water leaves the cup, it at once falls down between the guides already mentioned, and thus leaves the whole area of the air-valve open for the entrance of air. These cups are mounted in clusters of four, six and ten, being the equivalents of 6-in., 8-in. and 10-in. connections, and each cluster is fitted with a valve to be operated by hand, as already mentioned. Under each cluster is a shutoff valve, to be used in case of any defect in the air-valves requiring repairs. The air-valves used were made by the Coffin Valve Co., of Boston, Mass., who also made the intake gatehouse sluice gates, and gatehouse ironwork generally; all of it, in the most satisfactory manner. These air-valves were proportioned such that in the event of the pipe being cut in two at the most dangerous point, the water rushing out and the air rushing in would, between them, at no time cause more than ½ atmosphere or vacuum inside the pipe.

The air-valves are shown on plate 32, which need not be reproduced here. Since then their construction has been considerably improved. The 1890 air-valves had the defect that when by reason of the profile of the line, and of only a partial carrying capacity of the line in use, the hydraulic gradient coincided with the air-valve seat, the valve cups would oscillate, waste much water, and would finally "founder," instead of float; and thus let still more water run to waste.

On the 48-in. pipe line, 112,500 ft. long, there were placed (due to the computations made as above referred to), nine 6-in., twenty-four 8-in., and thirty-six 10-in. air-valves, frequently in clusters of two 10-in., or of a 10-

*Hydraulic Engineer, 2 Wall St., New York City.

†See description of the works of the East Jersey Water Co., "Jour. N. E. W. W. Accos.," September, 1893.

*"Jour. N. E. W. W. Assoc.," September, 1893, p 9; the other page references following are to the same source.

in. and an 8-in. inside of one and the same air-valve vault. The selected sizes and positions were the result of computations made by Reuben Shirreffs, one of the assistant engineers, late of Washington, D. C., now deceased.

The great question at the time was, would the earth covering of the pipe take up the pressure of the atmosphere in case of a pipe rupture, or would it unduly transmit it to the collapsible pipe; and the resolve to compute and proportion the air-valves so as to allow at the most only half a vacuum inside the pipe was a compromise made between conflicting emotions. There was no time to make experiments, as the account in the *Journal* shows.

The numbers and sizes of air-valves given foot up 4288 sq.in. of opening on 112,500 lin.ft. of pipe line; roughly speaking, an average of over 38 sq.in., or a 7-in. air-valve every 1000 ft. of pipe. But the sizes of air-valve for each location of such, along the pipe line, were carefully computed for the event of a pipe rupture at the most disadvantageous point, as has sufficiently been explained.

Collapse of the Antelope Valley Siphon, Los Angeles Aqueduct

We come now to the collapse of the Antelope Valley Siphon of the $28,000,000 aqueduct of the City of Los Angeles, Feb. 18-20, 1914.*

This was a 10-ft. riveted-steel pipe, in profile, in form of a simple siphon, the two ends open; about 6000 ft., at the two ends, of reinforced concrete; about 7000 ft. at the two ends, next after the concrete conduit, of steel pipe, only ¼in. thick; about 3500 ft. at the two ends, next after the ¼-in. pipe, of $\frac{5}{16}$-in. plates; and about 4600 ft., in the center, of ⅜-in. plate. The pipe was scant half buried in the ground.

All of the ¼-in. pipe, and most of the $\frac{5}{16}$-in. pipe at each end of the ¼-in. pipe, collapsed when some bridge piers, carrying the ⅜-in. pipe at the central part of the valley profile, were undermined by an excessive rain storm runoff, and the pipe was boken in two.

The question aries, how could water running out of such a siphon cause the pipe to collapse, so long as its ends were wide open? In the opinion of the writer, this is a case of the action of "negative pressure," while the pipe was still full of water.†

When the pipe broke in two suddenly at the lowest point of the valley profile, the water first flowed out with a velocity of some 114 ft. per sec.; a great enough velocity not only to remove all outward pressure at any point in the pipe, acting to keep it distended, but also great enough to set up "negative pressure," at points along the pipe under less than 200-ft. normal head, and *while such portions of the pipe were still full of water.*

We thus reach the conclusion that under the circumstances, the pipe may have begun to collapse either in the $\frac{5}{16}$-in. section, or at the top of the ¼-in. section; a process greatly aided by the unstable equilibrium of the summit (in cross-section) of a 10-ft. pipe, of the extremely thin dimensions that this one had—and laterally unsupported, practically, at its own diameter, at the ground level.

And the motion to collapse thus once begun, it is easy to see why it should have continued, following the shock of its beginning, and during the brief period of the emptying of the pipe line.

By the time the water levels within the siphon had reached the lower end of the collapsed portion, the velocity of efflux had diminished to some 40 ft. per sec., the pipe was gaining in thickness, and "negative pressure," within the contained water, no doubt ceased to exist; the air from the two ends of the siphon no doubt also followed the falling water surface within the siphon, and prevented any degree of vacuum. Hence the middle portion of the siphon, some 1200 ft. of $\frac{5}{16}$-in. pipe, and 4650 ft. of ⅜-in. pipe, remained in shape.

This aqueduct and its constructing and consulting engineers have been treated by the technical press for years past with such prominence, that the collapse of a portion of the works has caused this collapse to take part in the minds of many with some of the astonishing failures that recent years have produced,* *but it is not a case of the careless omission of air-valves,* as has been supposed. Criticism must be confined to the assumption of a too small, or not sufficiently secured, channel for flood runoff (the ordinary case of pier or culvert washout); possibly also to the toleration of extreme economy in the thicknesses of the plate selected for a 10-ft. pipe.

⁂

The Relation Between the Terminal Cost and the road cost in handling freight on the Central R.R. of Georgia was touched upon in a recent paper by E. M. Rhett read before the Southern & Southwestern Railway Club. An analysis was made of the cost of handling cotton at the Savannah terminal of the Central of Georgia Ry. for a period of five months. The analysis showed that the expense during this period for wages inside the freight station plus the switching and rolling stock expenses amounted to 55.6c. per ton. In other words, the cost of handling cotton a maximum distance of 2000 ft. in the Savannah terminal was as great as the entire cost of hauling the cotton over the entire length of the Savannah division of the Central of Georgia system. These figures for terminal cost would have been greatly increased had there been added to the expenses above given the cost of loading freight at the point of origin, the cost of rearranging it at some transfer station on the road for a long haul, and the interest and depreciation upon the terminal, tracks, real estate and buildings.

⁂

The Growth of Automobile Traffic on Roads is indicated by the road-traffic census which has been carried on under the direction of the Illinois Highway Commission since 1906. In the latest report reference is made to conditions on the road leading across the state from Chicago to Clinton. Observations made at Dixon and De Kalb in 1907 showed that automobiles represented respectively 4% and 2% of the total traffic. Observations made at the same points in 1912 showed that they then represented 50% and 33% of the total. At other points, automobiles represented as high as 58 and 63% of the traffic, these percentages being averages of observations taken four days each in May, June, August and September, 1912.

The conclusion is drawn that in any plans for systematic road work in many parts of the state, it must be considered that a large majority of the future traffic will consist of motor cars. Further, in many sections of the state there is opportunity for and probability of the development of motor truck traffic, so that future road building must take into consideration (for main roads) the use of 8- to 10-ton motor trucks. Many department stores, bakeries, furniture movers and other establishments in Chicago operate such trucks regularly within a range of 25 to 30 miles.

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*"Eng. News," Mar. 12, "Eng. Record," Apr. 18, 1914.

†For a proven example of "negative pressure," see the account of experiments made at the Holyoke, Mass., Public Testing Flume, by the writer, in "Harvard Engineering Journal," June, 1908, where a float gage repeatedly showed a closed box to be full of water, while at the same time a water-column vacuum gage, tapped into this box full of water, showed the mass of water within the box to be deprived of its natural pressure, to the extent of 14 ft. of water-column "vacuum."

*Such as the financial wreck of a $7,000,000 investment at the Soo Water Power plant, a power-house dam founded on piles, and yet without the slightest provision made to resist lateral forces; and the many million-dollar losses, caused by the fall of the Quebec R.R. bridge; not able, during erection, to hold up its own weight.

Progress in City Planning

Notable progress in city planning was made during the past year, according to the annual review of Flavel Shurtleff (19 Congress St., Boston, Mass.), secretary of the National Conference on city planning. Both the Massachusetts and Pennsylvania legislatures of 1913 made city planning mandatory; Massachusetts in all cities and towns of 30,000 population and over and Pennsylvania for a large number of cities. Under the stimulus of the Massachusetts Homestead Commission, which is in a way responsible for the administration of town planning, 24 of 32 Massachusetts cities with a population of 10,000 or more have adopted the act—making 30 Massachusetts town-planning commissions. In contrast, Pennsylvania, with no central body to oversee town planning, has as yet only eight town-planning commissions out of 60 municipalities of 10,000 population under the law. In each state municipalities not under the mandatory law have commissions, the total in Massachusetts being 30 and in Pennsylvania about a dozen.

Some Town-Planning Results

Striking accomplishments during the year in a number of cities were thus summarized by Mr. Shurtleff:

NEWARK—The Newark Plan Commission was appointed in 1913; the report of its expert advisors appeared early in 1914. On May 1, 1914, the City Council authorized a bond issue of $215,000, for carrying out the first recommendation suggested in the report of the Plan Commission, and at the same meeting authorized a bond issue of $1,600,000 for the construction of a new street, known as Diagonal St., which was the second recommendation in the Commission's report. The Public Service Commission of Newark has adopted very nearly all the suggestions of the Plan Commission with regard to rerouting and rescheduling the street transit of Newark and the Public Service Corporation is beginning to carry out the suggestions.

BROOKLYN—The Brooklyn City Plan Commission appointed a subcommittee of ten to report on a plan for downtown Brooklyn. Though the report was made only in the spring of this year, one of its most important features, the location of the new Court House for Kings County, has been officially adopted.

NEW YORK—The Height of Buildings Commission, appointed just before the Chicago Conference [held in 1913] has had enacted by the Legislature of 1914, an amendment to the charter of the City of New York which gives the Board of Estimate and Apportionment power to create districts with different restrictions as to height of buildings and percentage of lot covered, and to create residence districts from which will be excluded trades and industries.

CHICAGO—Beside considerable progress on the Twelfth St. improvement and the Boulevard Link improvement, the Plan Commission in Chicago has played a most notable part in winning what is described as the hardest fought civic battle ever occurring in Chicago. It was concerned with the location of railroad terminals on the west side of the city. The plan of the railroads which interfered seriously with the carrying out of the Burnham plan for Chicago has been finally abandoned and in the ordinance covering the location of the new Pennsylvania passenger and freight stations, which are advertised to cost between $40,000,000 and $50,000,000, practically all of the 18 recommendations made by the Chicago Plan Commission for the creation of new streets, viaducts, bridges, etc., were incorporated.

PHILADELPHIA—The most important single project is concerned with the readjustment of all the freight-carrying lines in the southern section of Philadelphia between the Delaware and the Schuylkill rivers. The abolishment of grade crossings (at a cost of $18,000,000), the relocation and elevation of railway lines, the acquisition by the city of waterfront property for the purpose of constructing municipal piers, and the general revision of the city plan over an area of approximately 4500 acres of land, are all included in this project, the details of which have been agreed upon between the city and the railroad companies and incorporated in an ordinance of the city approved in February, 1914.

A very important improvement commercially is the widening of Delaware Ave. for two miles along the waterfront. The new street will vary in width from 150 to 250 ft. Continued progress is being made on the establishment of Fairmount Parkway. Over 200 buildings have been torn down along the line of this diagonal, and the reservoir hill at the northwestern end is being leveled off preparatory to the construction of the municipal Museum of Arts.

BOSTON—Boston had no official Plan Commission until a few weeks ago, but its Transit Commission has completed plans for considerable extensions of the underground transit, all of which are now under construction. The much needed creation of a street in the heart of the congested business district between Washington and Tremont Sts., plans for which have been proposed for several years by unofficial planning bodies, was made possible by legislation of 1911, and the street is now being cut through, at an estimated cost of $1,300,000.

ST. LOUIS—In accord with the recommendation of the Plan Commission, the Municipal Assembly has passed an ordinance creating a sanitary district embracing 15,000 acres, in the western and southwestern parts of the city, and 52,000 acres outside the city. In the outer portion are located five small cities and a score of suburban villages. The plan of organization is designed to create a comprehensive drainage system for 150,000 people now dependent upon isolated systems and surface drainage. A new charter will be submitted to the voters in June, which includes a number of recommendations from the Plan Commission designed to facilitate the carrying out of parkway, recreation center and public-bath propositions by simplifying the methods of condemnation of private property and making use of the principle of special benefit as a means of distributing the cost of improvements.

Except for Hartford, Conn., city-planning commissions until 1913 were restricted to investigation and advice. The Pennsylvania town-planning act of 1913 requires all third-class cities in that state to submit ordinances affecting the physical development of cities to the local town-planning commission for approval. A Cleveland, Ohio, ordinance passed May 11, 1914, goes to the length shown by the following extract:

Hereafter no public building, harbor, bridge, viaduct, street fixture or other structure and appurtenance shall be located, constructed, erected, removed, relocated or altered until and unless such plan, design or location shall have been submitted to and approved by the Commission; and no such work when completed shall be accepted by the city until and unless it shall have been approved by the Commission as provided in Sec. 77 of the City Charter.

Whenever any ordinance or resolution relating to the plan, design, location, relocation, removal, extension or alteration of any such work is introduced into the Council, the City Clerk shall upon its introduction furnish the Commission a copy of such ordinance or resolution. The Commission shall, if it is deemed advisable, make a report in relation thereto for the consideration of the Council. If no report is submitted within 20 days after the receipt of such copy the Commission shall be deemed to have approved the provisions of such ordinance or resolution.

Other Advances

Excess Condemnation, or the taking of more land than is needed for a public improvement and the selling of the excess at a profit so as to reap the enhanced value created by the city, is provided for by statute or by constitutional amendment as follows: *Statute*: Massachusetts and Ohio, 1904; Virginia, 1906; Connecticut and Pennsylvania, 1907; Maryland, 1908; Connecticut (again), 1913. *Constitutional Amendment*: Massachusetts, 1911; Wisconsin and Ohio, 1912; New York, 1913.

The only known attempt to apply excess condemnation was under the Pennsylvania statute and this was declared unconstitutional by the State Supreme Court (Philadelphia Mutual Insurance Co., vs. City of Philadelphia). An amendment to the Pennsylvania constitution to meet this decision has been prepared. The excess condemnation principle has not yet been passed on by the U. S. Supreme Court.

PROTECTED RESIDENTIAL DISTRICTS—In conclusion, a paragraph on this subject may be quoted, as follows:

Legislation creating residential districts by limiting certain specified districts to residences, or by excluding from specified districts all or many kinds of trades or industrial occupations, was passed in 1913, in New York for second-class cities, in Minnesota for all cities over 50,000, in Michigan and in Illinois. Insofar as this legislation protects residential districts by excluding certain named industries on the ground that they endanger the general welfare of the residents, it does not differ materially from the police ordinance in force quite generally in both Canadian and American cities. The catalog of excluded industries is probably somewhat lengthened. But New York legislation prohibits any use of certain named areas except for residences of a particular kind, and immediately the question is raised whether such an act can be defended as properly within the police power.

Saving Old Macadam Pavements in Philadelphia*

The practice adopted in connection with bituminous surface treatments† consists of applying from ¼ to ½ gal. of bituminous material to the square yard, and then spreading over the surface from 15 to 30 lb. of fine washed gravel or clean trap-rock chips, the quantity and character of these materials depending upon the condition of the road, the nature and character of traffic to which it is subjected, grades and local and social conditions.

In each particular instance, a careful study is made of these conditions before deciding upon the character of the material to be used. In 1912, none of the macadam roads were in a condition fit for applying bituminous surface treatments until after they had been resurfaced or repaired late in the season, consequently most of the bituminous material used consisted merely of a dust-laying material and was applied to roads in poor repair simply for the purpose of laying the dust. In 1913, a more permanent character of bituminous material was used which not only does away with the dust nuisance, but is designed to preserve the roads.

If the policy adopted is continued and similar material applied when necessary, about 200 miles of macadam pavements throughout the city can be placed in first-class condition and maintained almost indefinitely at a very low cost. During the past year, 40.81 miles of pavement were placed in first-class condition through the application of bituminous surface treatments, at an average cost of $0.073 per sq.yd.

PATROL INSPECTION—All the macadam pavements surfaced or resurfaced by the city in 1913 have been subjected to periodic inspection, through the installation of a patrol maintenance system, and by this method it is possible to maintain all the improved roads in good condition at all times. As the ultimate cost of the maintenance of macadam roads depends primarily on the promptness with which repairs are made, the adoption of this periodic patrol-inspection system will result in a saving, and at the same time will maintain the roads in the best possible condition for traffic.

BITUMINOUS SURFACE TREATMENT OF OLD WATER-BOUND MACADAM PAVEMENT, LINCOLN DRIVE, PHILADELPHIA, PENN.

*From the 1913 annual report of Wm. H. Connell, Chief of the Bureau of Highways, Philadelphia, Penn.

†For further particulars in regard to methods of surface treatment of macadam roads with bituminous binders as practiced in Philadelphia, see paper by Mr. Connell, "Engineering News," Jan. 1, 1914, p. 42.

Tests of Railway Signal Observance made on the 22 divisions of the Pennsylvania R.R. in February last show that in every one of 11,979 tests made the rules were correctly observed. During the same period on the entire system east of Pittsburgh and Erie, 689,099 safety observations were made to ascertain the observance of the various rules relating to the safety of trains, and 99.9% showed perfect performance. 1093 observations were made to see if switches were left in proper position and 260 tests of the rules requiring a brakeman to take the place of the rear flagman when the latter goes back to protect his train, in both instances without a single case of failure.

The Motor Bus and Municipal Problems Pertaining to Its Operation*

By John A. McCollum†

The date of the first appearance of the horse-drawn omnibus in London is not definitely known, but it is certain that corporations owning and operating such vehicles were in existence as early as 1855, and during the year 1862 more than 42,000,000 passengers were carried by the 600 vehicles of one company alone. The maximum number of horse-drawn vehicles was reached in 1901. In this year 3736 were licensed. Subsequent to that time the number gradually decreased until a few months ago, when the last horsedrawn omnibus was removed from the streets of London.

The new era began in 1901, when 10 motor busses were licensed by the police. No large increase in numbers took place, however, until 1905, when 241 vehicles were licensed. From that time down to the present, the numbers increased by leaps and bounds. There are at present in London more than 3000 motor-driven busses, which have entirely supplanted the horse-drawn vehicles. These have a seating capacity of 34 passengers each; operate on regular schedules; move with an average speed somewhat in excess of the surface railway cars, and carry with regularity and dispatch, at a rate of fare exceeding by only 20 per cent. that of the street railways, an aggregate of 676,000,000 passengers per annum, a total greater than the number of cash fares and transfers collected on all the street surface railways of the Boroughs of Manhattan and the Bronx in the city of New York. This seems miraculous when we consider the short period within which motor-driven vehicles have been developed and adapted to this severe use.

The operating efficiency of the motor bus in London may be well illustrated by the fact that during seven continuous months of the year 1913 about 2200 motor busses ran an average of 117 miles each per day, or an aggregate of 55,000,000 bus miles, with a loss of scheduled mileage equal to only 0.12 of one per cent. of the total. This probably exceeds the efficiency of many street railway systems. In Paris there are more than 1000 vehicles of a type unlike those in London, operating under different conditions, but performing nevertheless an efficient passenger service. New motor bus routes are being established daily in European cities.

There are two characteristics of the motor bus which distinguish it from every other public transportation facility. The first is flexibility; that is, flexibility of vehicle movement and flexibility of route. Because of this feature the vehicle responds quickly to operating requirements and to traffic conditions; e.g., passengers may enter or leave busses at the side of the roadway without risk or danger of crossing dense vehicular traffic; delays to other motor cars do not result from breakdown either of a motor bus or any other vehicle, and daily or less frequent changes of route may be made to comply with traffic conditions. All of these are advantages not to be found in any car confined to rails.

The second distinguishing characteristic is its independence of extraneous equipment, such as expensive and delicate power generating and distributing systems or expensive track equipment. The railway investment must, in a large measure, increase in the same ratio as the length of the track, while the motor bus investment grows only in proportion to the number of vehicles employed or, what is the same thing, in proportion to the daily vehicle mileage.

The importance of this feature is shown by the comparison of the capitalization of the street railways in the Boroughs of Manhattan and the Bronx and the municipally owned and operated surface railways in London with the largest omnibus undertaking in that city. The number of passengers carried in the year 1912 by the London railway was about the same as the number carried by its omnibus system. In Manhattan and the Bronx the total number of passengers paying cash fares and presenting transfers exceeded by about 20 per cent. the number carried by the London omnibus system. The aggregate lengths of route operated were about 148 miles by London railways, about 230 miles by Manhattan and the Bronx railways and more than 300 miles by the London motor busses. Yet at the close of 1912 the London railway investment, less the accumulated sinking funds, was $53,000,000; the Manhattan and the Bronx railways' capital was $190,000,000, with an appraised property value of $166,000,000; while the amount of capital employed by the omnibus company, as evidenced by its outstanding securities, was only $15,500,000, including an increase during the year of $5,000,000 for the purpose of providing funds for additional facilities, the benefit of which will accrue in subsequent years.

Thus we find that the London railway investment is about 3½ times that of the omnibus. The capitalization of the street railways in Manhattan and the Bronx is more than 12 times and their appraised value is almost 9 times as great as the capital used for London omnibuses. Five per cent. profit upon the capital of the railways of Manhattan and the Bronx would equal more than 13c. for each car mile operated. The following general comparisons may be made between the operating expense of the largest existing motor bus undertakings and that of the street railways:

In London, where the operation is skillfully managed, where the pavements are kept in excellent repair and where the improvement in the type and construction of vehicle has been most rapid, we find that the bare operating cost is relatively low. It is less than 15 cents per bus mile and probably does not exceed by more than 10 to 15% the cost per car mile of the municipally owned surface railways. The excess cost is, however, more than offset by the lower interest charges on motor bus operation, and the total cost per bus mile probably is less than the cost per car mile. The relative seating capacity of vehicles used in this comparison is 34 for the motor bus and 78 for the surface car. This ratio of seating capacity brings the total cost per motor bus seat mile greater than that of the car seat mile. In Paris, where a much heavier vehicle of about the same capacity is operated on pavements less smooth, the cost per mile is considerably greater than in London.

Many conditions abroad bearing on the cost of operation differ from those in America; e.g., the comparatively low cost of labor in England, particularly mechanical labor, of which so much is required in motor omnibus operations.

The depreciation of the motor bus is much more rapid than that of the street railway car and other railway equipment and requires provision for replacement funds at a greater rate. The total amount of depreciation may not exceed that of the railway, although the rate is higher, because the value to which the rate is applied is much less. In London the life of motor bus equipment is estimated to be from five to six years, and in New York depreciation funds are provided sufficient to replace the vehicles after three years' use. Probably the average life of motor buses constructed abroad when efficiently maintained is much longer than five years, but the mechanical improvement in type and construction has been thus far so rapid that the vehicles become obsolete before they are worn out.

Street pavement is to the motor bus what the steel railway track is to the railway car, but unlike the railway track it is provided at public expense. Its preservation, therefore, is one of the problems which will confront the authorities if large numbers of heavy motor buses are to be operated, particularly in suburban districts, where the pavements are usually less permanent than in city streets with dense vehicular traffic.

The capacity—hence to some degree the weight—of the motor bus is an extremely important consideration from the standpoint of economy, for the cost of operation per vehicle does not increase at the same rate as the number of persons which it may carry. Therefore, where the volume of traffic is sufficient, a larger vehicle is more desirable. Speed and rapid acceleration up to certain limits are also essential for passenger service. In consequence, reduction of weight per unit capacity or other improvements in design must be depended upon to keep down road repair cost rather than reduction of speed in motor bus operation.

Motor busses operated in London, Paris and New York vary in weight from 219 pounds to 365 pounds for each passenger which the vehicle is capable of carrying. The lightest vehicle is used in London and weighs about 3¾ tons unloaded. This is the maximum weight permitted by the police for a public service vehicle. It is possible to obtain American-made single deck buses, 24 passenger seating capacity, that probably do not exceed in weight the maximum per passenger capacity authorized in London. Whether those vehicles will prove successful in the severe trials of motor bus work is yet to be proven.

There is a great need for a careful research into the whole problem of mechanical traction on roads, particularly the effect of vehicle weight and speed upon the cost of road maintenance. If it is shown that the motor bus is particularly destructive to roads, the operators should pay something toward road maintenance.

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*From a paper read before the National Conference on City Planning at Toronto, May 27.

†Assistant Engineer Board of Estimate and Apportionment, New York City.

Steam-Heated Self-Propelled Road Oiling Machine

The machine illustrated herewith is designed for applying hot the heavy so called permanent type of bituminous road binders and not the lighter oils and emulsions. The particular machine shown has been used successfully with the Standard Oil Co.'s asphalt binder "B," an asphaltic material which melts at 118° F. and has a penetration of 120 by the standard test of the American Society for Testing Materials.

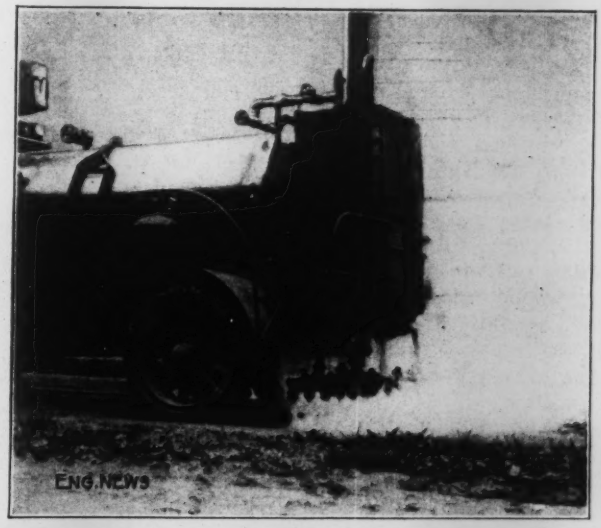
The truck itself is a 5½-ton Hewett gasoline truck made by the International Motor Co. The large 750-gal. tank is for the road binder, which is received hot through the vertical cylindrical funnel tank on top.

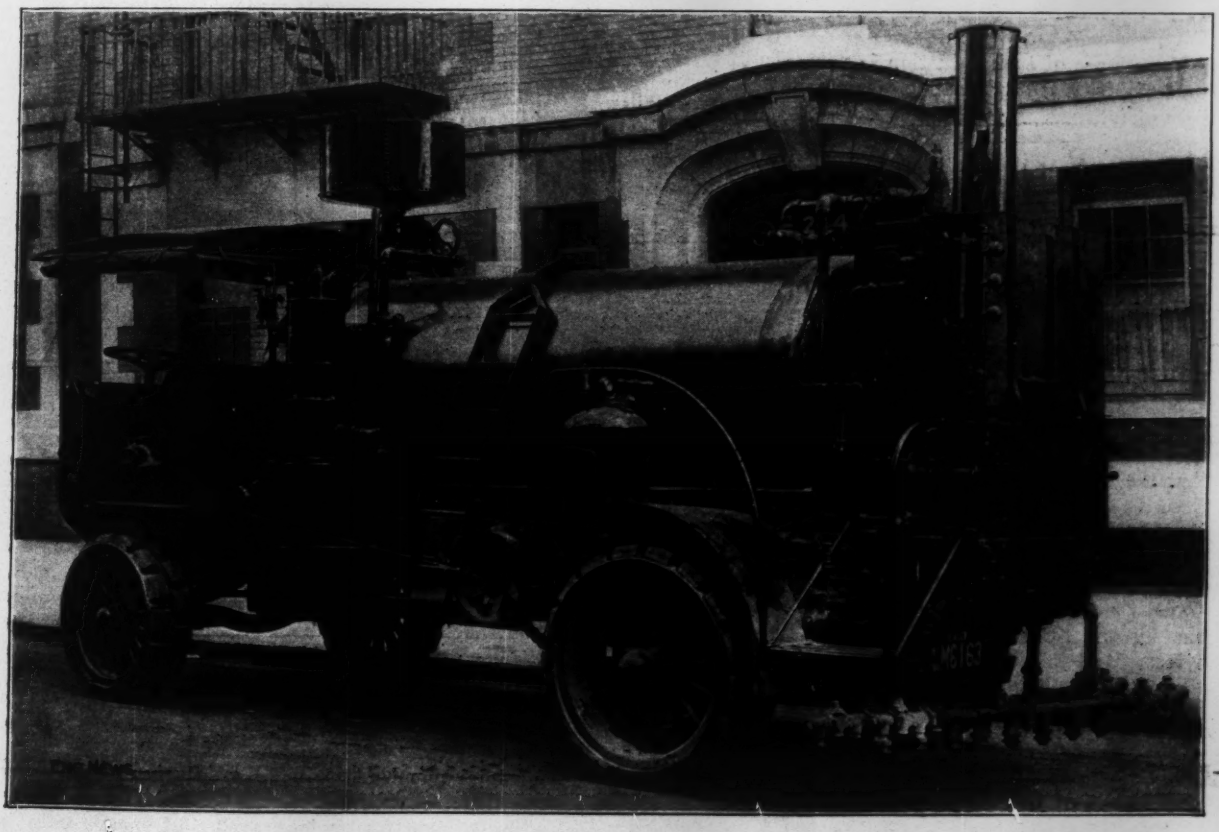
Inside the large horizontal tank are 250 lin.ft. of copper tubing, through which live steam circulates at a pressure of 110 lb. This steam is generated in a Roberts safety flash boiler at the rear of the truck, the boiler being fired with fuel oil carried in a small 30-gal. horizontal tank on the farther side of the truck, not shown. A larger 100-gal. tank below the fuel-oil tank carries water for the boiler. There is also a small hand air-compressor or primer for starting the fire under the boiler.

On the right-hand side of the truck as shown is a Westinghouse air-compressor of the locomotive air-brake type, which gives an air pressure of from 40 to 60 lb. The compressor furnishes the means of forcing the asphaltic binder from the tank through the steam-heated whirling nozzles upon the road.

The sprinkler operator is stationed at the rear of the truck directly above the nozzles, so that he can watch their action and control and regulate the feed, by varying the air pressure, opening or closing one or several of the nozzles, changing the temperature of the tank or by having the truck run at different speeds.

The chief special feature of the machine, which has been patented, is a means by which live steam at 110 lb. pressure may be turned directly into and through the spraying gear, thus keeping it clear of any hardened binder. The spraying apparatus was designed by C. Hvass & Co., New York City.





STEAM-HEATED ROAD OILER FOR HEAVY ASPHALT BINDER

The Engineering Profession and the American Society of Civil Engineers*

By Hunter McDonald†

It is a matter of pride and cause for congratulation that the most stupendous work of civilization, the Panama Canal, is about to be presented to our Government by men of our profession, completed greatly in advance of the time when it was due and absolutely free from any taint of scandal, graft or incompetency in any of the stages of its progress.

Fresh from the glories of this achievement our Government has entered upon two more gigantic tasks to be performed in untried fields. These are the valuation of the railroad and telegraph properties of the United States, and the building of railroads in Alaska. The first of these projects is engaging the thought and time of a large number of our profession and has already resulted in greatly increasing the demand for and compensation of engineers at a time when, on account of general stagnation in industrial developments, many would otherwise be idle.

In this work engineers have the opportunity to show to the country that they, more than any politician or lawyer, are qualified to ascertain and fix the underlying principles upon which this valuation should be made, and then to follow this up by the actual working out of the results.

It is not for us to say whether the game is worth the candle or not, but to address ourselves to the task set before us and demonstrate our fitness for the responsibility.

The science of such valuation is new. In 1897, it became my duty to serve as one of a committee to value a piece of railroad property for a joint terminal. Being inexperienced, I sought from the pages and editors of technical journals and from other engineers some information as to the basis for such valuation. I was unable at that time to secure it. Now there is so much in print on the subject that it is with difficulty that the chaff can be separated from the grain.

A commission of engineers is now charged with the duty of selecting a route for the main line of a railroad from some harbor on the southern coast to the central part of Alaska and to determine what and where branches are to be built. When the location is determined, it is probable that the building of the roads will be entrusted to the Corps of Engineers, U. S. A. It seems improbable that the roads will ever be operated by any agency other than the National Government. An opportunity presents itself here for civil engineers to demonstrate their fitness for responsibilities other than the mere application of mathematics. A civil engineer is now Governor of the Canal Zone, and another should be General Manager of the Alaskan Railroad when the time for its operation arrives. It goes without saying that his staff should be composed of engineers. An engineer has recently been chosen as manager of one of our large cities. Many are being placed on City Commissions.

Persons who are charged with the responsibility for the wise expenditure of public money are more and more inclined to turn to the engineer for advice as to how to do it, and to recognize the fact that civil engineers are fit for something else besides the preparation of blueprints, setting stakes and running instruments. We are now upon the threshhold of new responsibilities and we must set ourselves faithfully to the task of preparing to meet them. Good engineering consists largely in meeting emergencies with the resources at one's disposal. The man who does it is always in demand.

Believing it would be interesting to know the number of the various kinds of engineers which go to make up our membership, I requested the Secretary to prepare from the list of members a classification. After much labor it has been accomplished, as follows:

19.72% of the total membership gave no special occupation and could not be classified. The tables are based on the 5864 whose occupation is so given as to enable a probable accurate classification.

Out of 2703 members 384 or 14.2% are employed by railroads, of whom 102 are Chief Engineers, 200 Assistant Engineers, the remainder being other officials.

280 or 10.3% are employed by the National Government, 55 being officers in the Corps of Engineers, 163 Assistant Engineers, 14 Chief Engineers, 26 Civil Engineers and 3 Consulting Engineers.

124 or 4.6% are employed by states and counties, 318 or 11.8% are employed by municipalities, 124 being Chief Engineers, 163 Assistant Engineers, and 2 Consulting Engineers.

647 or 23.9% are employed by private companies or individuals, 284 being classified as officials, 125 Chief Engineers, 183 Assistant Engineers, 18 Consulting Engineers and 7 Civil Engineers.

116 or 4.3% are employed in engineering education as professors and instructors.

673 or 24.9% are in private practice, of whom 545 are Consulting Engineers, 92 as Contracting Engineers, 36 as Architects. There are also in private practice 10 Mechanical Engineers, 1 Electrical, 15 Sanitary, 59 Hydraulic, 28 Structural, 19 Mining, 3 Chemical and Metallurgical, 2 Highway, 2 Heating and Ventilating and 22 Miscellaneous.

Of the 2444 Associate Members, 295 or 12.1% are employed by railroads, 23 being Chief Engineers, and 246 Assistant Engineers, 250 or 9.8% are employed by the National Government, principally as instrumentmen and Assistant Engineers, 216 or 8.9% are employed by States and Counties, 44 as Chief Engineers and 162 as Assistant Engineers, 328 or 13.4% are employed by municipalities, 73 being Chief Engineers and 232 Assistants, 105 or 4.3% are employed in engineering education as professors and instructors. In general private practice there are 325 or 15.2%, of whom 229 are Consulting Engineers, 80 contracting Engineers, 14 Architects, 3 are Mechanical, 2 Electrical, 9 Sanitary, 38 Hydraulic, 20 Structural, 12 Mining, 2 Chemical and Metallurgical, 3 Highway and 14 Miscellaneous Engineers.

Associates are largely employed as Superintendents and other officials under private companies and individuals. There are 113 in all.

Of the 588 Juniors, 64 or 10.9% are employed on railroads, 59 or 10% by the National Government, 71 or 12.1% by states and counties, 80 or 13.6% by Municipalities, 245 or 41.7% by private companies and individuals, 39 or 6.6% in engineering education. It appears that 20 are Consulting Engineers, 12 of these are in general practice, 2 Sanitary, 2 Hydraulic, 1 Structural, 1 Mining and 1 miscellaneous.

While the growth of our Society has been phenomenal and the standard of our membership is generally maintained at a high level, there is a widespread feeling that there is something wrong and that we are not accomplishing the good there is in us. The third article of our constitution reads as follows:

Its objects shall be the advancement of engineering knowledge and practice, and the maintenance of a high professional standard among its members.

Our total membership in all grades is over 7400. I believe there are fully 40,000 men in the United States who are eligible for various grades of membership in

*Condensed from the Presidential address before the American Society of Civil Engineers at the annual convention in Baltimore, June 3.

†Chief Engineer, Nashville, Chattanooga & St. Louis R.R., Nashville, Tenn.

about the same proportion as the list is now made up. It is hardly safe to assume that the reason they are not members is because they cannot afford to be. I think it is safe to assume that while they value the prestige of membership, they feel that the benefits are too remote. The engineer's calling generally imposes isolation and yet they all dearly love companionship and exchange of ideas with one another.

What we need and ought to have is the establishment of state organizations and of sections in all important cities. This matter has been studied by a special committee and discussed at one of our annual meetings but because we felt that our duty ended with the welfare of our own members, as provided in the constitution, the project met with no encouragement.

It is true that we permit local members in large cities to band together and call themselves Associations of members of the Am. Soc. C. E., but they, as organizations, have no voice in our government, cannot mingle with other local organizations, and except in very large cities where no other sections already exist, the formation of prosperous associations is impossible. The history of such local associations is by no means flattering to our pride or good management.

The result of our narrow policy has been that organizations, embracing members of all the callings allied to civil engineering, have sprung up in nearly all cities of 100,000 inhabitants, and other national engineering societies have their own local sections established in many of these centers, and are coöperating with other local organizations. Some of these societies are by no means local in scope.

In the independent local organizations, the membership in many instances has not been of so high a standard as our own because of the necessity for a large membership in order to meet expenses, and, like the German and Canadian National Engineering Societies, all classes are taken in. Nearly all of these organizations contain some of our own members who have joined, sometimes as a matter of civic pride and more often because they found at home that companionship which could not reach them through the medium of our transactions from New York. All but a few of these local organizations are struggling for existence and are unable to publish their papers and discussions. Some are prosperous, and one in Boston antedates our own organization by several years.

It is the duty of our Society to extend a helping hand to all who need it, and to take the initiative in an effort to gradually amalgamate all engineering organizations into one homogeneous and coöperative mass, permitting each, as far as possible, to retain its name and identity. Some sacrifice on the part of all would no doubt be necessary. Union has not been possible among religious sects, but as I have heretofore shown, engineers are of necessity managers and with their spirit of fair play and good sense ought to be able to get together. Call it what you will, the American Engineer Confederation, or better still, the American Confederation of Civil Engineers.

I would not lower our standard of requirement for membership, but by extending to local societies limited financial assistance where needed, we can raise the general standard, and in doing so, can so elevate the profession at large as to make a printed code of ethics unnecessary.

The time has come for the engineer to possess his own. The public is awake to the advantages of sound engineering advice. We have it in our power, without taking sides in political contests, to exert a beneficial influence in National, State and Municipal affairs. Some of the matters in the conduct of which we should exert a marked influence are the following:

We should seek to stop the economic waste caused by the adoption of unworthy projects for internal waterways and harbors, the means for which are often wrung from Congress on padded and duplicated commercial statistics, the principal object being to aid Congressmen in election.

We should seek to have the civilian engineers in the employ of the Government given proper recognition of their services in the matters of credit, rank, salary and retired pay.

We should see that the mad schemes for flood control of our rivers are punctured before money is expended on them and that practicable schemes, considering the entire drainage basin as a whole, are adopted and their execution begun on a sound basis as soon as possible.

In every state and in every city we should lend our organized influence toward the securing of safe and sane building laws, free from the bias of selfish private interests and trade unions. We should see that public moneys derived from bonds and taxes are not squandered on impossible and unnecessary projects and which have not received proper engineering scrutiny. That sanitary officers are chosen for their fitness and not because they write M. D. after their names. That sanitary methods of water-supply and sewage disposal are adopted in the rural districts. We should make use of the secular press in all legitimate ways in order to bring before the minds of the public at large the importance of the engineer in civil life. Whenever we let the people know that we are organized, not only for our own improvement and protection, but for the public good, we need have no fear of not receiving proper consideration. We are wont to twit our medical friends on the fact that they often bury their mistakes, while ours stand to plague us but we dare not compare records with them on charities or patriotism.

It is not here contended that we should, as individuals, render free service to communities, but that organized action should be taken on all matters where engineering advice will be useful in shaping public policy. Such organized action will bring about recognition of the engineer and stimulate demand for engineering advice.

Before undertaking to show others what they ought to do, we should first put our own house in order. Good engineering is good management. From the financial statement it would appear that our Society is in a very prosperous condition, but are we getting all that we can out of our present resources?

Our Society house is located in what is fast becoming the business district of New York City. The present value of the land and building is not less than $600,000. Two large rooms are maintained as auditorium and assembly room, respectively, and used once every two weeks by an average of about 175 persons and once a year by about 700. They are too large to be comfortable for small gatherings. About 25 persons are generally employed in the building. Interest on the value of the property at 5% makes the rental we pay for these privi-

leges about $30,000 per annum. It would seem possible and wise to issue bonds and erect a building, portions of which could be rented for a sufficient amount to pay our interest, establish a sinking fund and give us rent free. The upper floors should be rented, preferably to engineer tenants, the street floors to merchants. The top part of the building would supply our offices, auditoriums and perhaps a roof garden. The architectural possibility should atone for any fancied loss of dignity. Using elevators now-a-days in not considered a hardship. The amount now devoted to rent would go very far in aiding struggling local sections.

Pending the working out of these larger problems there are minor steps which can be taken at once which will add to the value of our membership.

The classification which the Secretary has inaugurated should be a regular annual feature and each member requested to return his calling at the same time as he does his address. Steps should be taken to provide automatically for transfer to the Associate Class of all members who abandon engineering practice and devote themselves exclusively to the promotion or sale of patented articles and appliances.

The provisions for expelling members guilty of improper conduct should be made less complicated and the power be placed in the hands of the Board of Direction. The Board of Direction should be empowered, and required, to espouse the cause of any member who is the subject of unjust attack. Fees should be paid members for creditable extracts of engineering articles appearing in our publications and the advisability of continuing the monthly notes of important engineering articles, now published in the *Proceedings*, should be investigated.

I am not now prepared to suggest methods by which the ideals, which I have heretofore rather vaguely outlined, may be brought into realization, but I feel that whenever a thing ought to be done, a way can be found to do it, and I believe a representative committee of our Society should be appointed to study what we ought to do and how to accomplish it.

Annual Convention of the American Society of Civil Engineers

A large number of members and guests—that is, large for a summer meeting—attended the forty-sixth annual convention of the American Society of Civil Engineers at Baltimore, Md., June 2 to 5.

Of the three brief formal sessions one was devoted to the presidential address of Hunter McDonald, of Nashville, Tenn. (printed in part elsewhere in this issue); one was taken up with the consideration of the proposed Code of Ethics and a little minor business, and one was occupied with brief talks describing public works of Baltimore which were to be visited by the convention.

Social and other entertainment features were: A golf tournament at the Baltimore County Club; an all-day excursion to Annapolis, with lunch and supper on the boat and the whole afternoon at the Naval Academy and in its vicinity; trips to inspect the water-supply, sewerage, paving, and harbor works of Baltimore; and a visit to the plant of the Maryland Steel Co., at Sparrows Point; a ball and reception given by the Engineers Club of Baltimore; an informal reception Monday night and a farewell smoker on Friday evening.

Proposed Code of Ethics

The Code of Ethics, as drafted by the Board of Direction, gave rise to an hour of lively discussion, but was finally approved by the meeting and ordered sent to letter ballot. The Code (see Eng. News, Apr. 30, 1914, p. 987) named six things which it shall be considered unprofessional for any member of the Society to do. Written and oral discussion disclosed comparatively little opposition to the Code as submitted. Such opposition as appeared, and as was not due to misunderstanding, was chiefly to the effect that since the code goes no further than to reduce to writing the unwritten code of professional conduct already followed by reputable members, there would be no advantage in adopting it. T. Kennard Thomson (a member of the Board of Direction) thought the code did not go far enough and moved that it be referred back to the Board with instructions to make it stronger. This amendment received substantially no support. Edwin Thacher submitted an amendment declaring it unprofessional to knowingly infringe upon the patents of another engineer and to accept fees therefor, thus laying oneself open to criticism by the patentee. A rapid fire of objections to this amendment followed and it was voted down by many loud nos, with not even a faint aye. Another amendment voted down was aimed against a member bidding as a contractor in competition with other contractors on work for which he had drawn plans and specifications. No one defended the practice, but the amendment was considered to be against the plan of the Code, which is designed to lay down a few broad professional principles and to avoid all details. The discussion brought out opinions from some to the effect that means are lacking to discipline a member for unprofessional conduct.

Public Works of Baltimore

Short talks by the engineers of various city improvements served as preparations for a better understanding of the inspection trips made on Thursday afternoon. Four trips were arranged. These were led by and the works visited were previously outlined as follows: (1) City Planning and Paving, Joseph W. Shirley, Chief Engineer Topographical Survey; R. Keith Compton, Chief Engineer Paving Commission; H. K. McCay, City Engineer; F. W. McKinney, Chief Engineer Street Openings; (2) Drainage and Sewerage, Calvin W. Hendrick, Chief Engineer Baltimore Sewerage Commission; (3) Harbor Work, O. F. Lackey, Harbor Engineer; (4) Water-Supply and Filtration, Ezra B. Whitman, Water Engineer and President Water Board.

A feature of the sewerage trip was a lunch in a 29-ft. drainage tunnel. On the water-supply trip there were seen some large reinforced-concrete pipe being laid in an old water tunnel; the new 128,000,000-gal. mechanical filter plant now under construction; and the new Loch Raven Dam.

Brick and Concrete for Country Roads in Ohio—More than one-third of the 573 miles of roads to be improved during the current year by the Ohio State Highway Department are to be surfaced with brick or concrete, according to a recent "Highway Bulletin."

Convention of the National Electric Light Association

The thirty-seventh annual convention of the National Electric Light Association was held in Philadelphia, June 1 to 5. The various meeting halls (as many as three parallel sessions being held at once) were in the Bellevue-Stratford Hotel and on its roof garden was the manufacturers' usual exhibit of latest lighting equipment, etc. There were, of course, all the expected entertainment features. The total attendance registered was 4000.

The more serious work was inaugurated with an address by Mayor Rudolph Blankenburg, who welcomed the visitors with a characteristic personal greeting that was more than perfunctory.

The following officers were elected: President, Holton H. Scott, of New York; Vice-President, E. W. Lloyd, of Chicago; H. A. Wagner, of Baltimore; L. D. Gibbs, of Columbus, Ga.; Secretary, T. C. Martin, of New York; Treasurer, W. F. Wells, of Brooklyn, N. Y.

The regular features of presidential address (J. B. McCall, of Philadelphia), Secretary's report (T. C. Martin, of New York), and report of Committee on Organization of the Industry (H. H. Scott, of New York) reviewed the association year's activity. The Progress Committee report (T. C. Martin) went a bit further. While it gave statistics of general conditions and development, and notes on improvements in electricity-using devices, it also argued against the recent impeachment of holding companies by the President of the United States.

Many of the program items were of special interest to this electrical industry and others were of wider engineering application. The more important are reviewed below—without regard to the sessions at which presented.

General Papers

Accident Prevention—The Committee on Grounding Secondaries (W. H. Blood, Jr., Boston) gave a rather pessimistic account of progress in the very important work of connecting secondary circuits of alternating-current systems to ground as a protection to the lives of customers who may touch fixtures after chance puncture of insulation between high- and low-tension circuits. Out of 575 companies responding to requests for information, only 325 were so grounding; the smaller companies were the ones taking this serious risk. Out of the 222 localities where grounding to water pipes was allowed only 112 companies availed themselves of the privilege in spite of the known questionability of other means (driven pipes, buried plates and cones, etc.). In the discussion of this report strong emphasis was placed on the liability of any company not grounding to severe punishment by the courts for obvious criminal negligence.

The report of the Accident Prevention Committee (M. T. Insull, Chicago) contained reprints of (1) a booklet giving detailed scheme of organizing safety work among employees; (2) a set of general precautionary rules and a booklet "Safety Rules for Employers;" (3) uniform blanks for reporting accidents to the Association and a uniform scheme of tabulating the results; (4) uniform danger signs to be used by this and other associations. Copy has also been prepared for a book, to be issued later, on "First Aid." The Committee also showed a moving-picture film, "The Lineman," to be used by member companies in demonstrating safe and dangerous ways of working.

"Safety First" was the title of the annual presentment of wit and warning from Paul Lupke of Trenton; this time he discussed the development of an accident-prevention spirit among employees.

Lamps and Lighting—The Lamp Committee (F. W. Smith, of New York) gave the results of its annual scrutiny of development; it showed that the old carbon-filament incandescent type had dropped from 25.5% to 11.85% of the total production while the metallized-carbon had slumped from its steady rise (to 33.6%) by going off to 31.4%. The tungsten-type has continued upward from 39.9% to 56.7%. The tantalum had practically disappeared—going from 1% to 0.09%. The Committee appended a history of the development of both arc and incandescent lamps and presented an exhibition of all the old and new types, burning; there were the new inert-atmosphere tungsten-coil types, quartz-tube mercury arcs, new flaming arcs, etc.

The Street-Lighting Committee outlined the steps of an investigation which it had under way to determine reliable data on good street lighting. Two streets have been secured in New York City for experimental equipment and the work will go forward this summer. The counsel of an eminent advisory committee has been secured; notable among its members is Prof. Hugo Munsterberg, the well known psychologist who has brought for the first time to any such study in acceptable form the criterion of mental effect and tests.

A Committee on Lighting of Interurban Highways (G. B. Tripp, of Harrisburg) called attention to the provisions that were being made for lighting important improved roads other than by vehicle headlights and urged this as new business for central stations. Available equipment was briefly described and the few actual installations of this sort were pictured.

Steam and Hydraulic Motors—The Committee on Prime Movers (I. E. Moultrop, of Boston) made brief dissertations on use of oil fuel in quick starting of stand-by boilers, a 16% decrease of operating cost by using blowers to force boiler evaporation in peak loads, means of preventing emission of hard cinders, cheap pits for submerged coal storage, foreign boiler and engine practice, American manufacturers' developments, hydraulic vacuum pumps, continuous water-wheel discharge measurements, a claimed recedence of gas-engine and producer use, the development of an American type of Diesel oil engine, etc.

The paper, "Water Power Economies," by O. B. Coldwell, of Portland, Ore., was a general outline of the features of design, construction and operation of hydro-electric works affecting economy of service—flow characteristics, types of dams and headworks, conduits, penstocks, main units and auxiliaries, control, etc.

C. V. Seastone, Madison, Wis., in the paper "Selection of Hydraulic Turbines" pointed out the need, frequently neglected, of securing those turbines which generate the most power for the water passed under the prevalent conditions. The great utility of flume tests of runners was emphasized and the selection, according to proper type, size, runner and general design as adapted to local conditions, was very generally set forth.

Electric Vehicles—Dr. C. P. Steinmetz made an address on this subject, in which he showed that automo-

biling, as a sport, had not quite reached its culmination but showed evidences of an early decline similar to that which had been seen in the sport of bicycling. The days of long cross-country rides were limited he believed, and when that side had become unimportant, the automobile would reach its final state of business and pleasure use in and about towns with a possible working radius of some 30 miles. When this steady state had been reached, the gasoline-propelled machine with its great amount of machinery and care required could not compete in satisfaction or cost with the light electric car. He pointed out, as the "car of the future," a light but strong machine costing not over $500, and he warned the central-station men that here was the greatest chance in the history of their art to secure a strictly off-peak business. To secure satisfactory results, he expected that the central stations would have to erect their own public garages into which the car owners would turn their machines for night charging and perhaps care. If left to private garages, they would only stimulate a new class of isolated plants. He showed the possibility of doing this at some $5 to $10 per month and of developing all over the country an off-peak load of 1500 million kilowatt-hours; up to 5c. per kw.-hr. might be obtained which would mean an income of $75,000,000 without extra capacity needed.

RATES—The general topic that attracted the largest attendances and provoked the most animated and prolonged discussion was rate making. The Rate Research Committee (E. W. Lloyd, Chicago) briefly noted its year's activity (largely in publishing the bulletins which make up "Rate Research") and presented an exposition of the "value-of-service" theory as a basis of adjusting detailed rates after the broad problem of finding "fair return on fair value" had been solved. The trend of discussion did not support the Committee's apparent belief in this as generally more applicable than a "cost-of-service" basis, but showed that nearly all looked on cost as the most direct and dependable basis to start off with and to depart from when data fell short or peculiar conditions (like off-peak stimulated load) intervened.

A Committee on Non-Peak and High-Load-Factor Business (G. H. Jones, Chicago) called attention to the advisability of making rate schedules and policies such as would allow building up of off-peak business so that apparatus would not be idle so much of the day. This business was grouped under two heads: (1) developed—battery charging, ice making, etc., and (2) underdeveloped but promising—electric furnaces, electrochemical industries, etc. One significant passage in the report advised members to admit frankly that there were some classes of isolated-plant prospects, like large hotels and office buildings where considerable amounts of steam had to be used, that the central station could not take over economically. In such cases, members were advised to cultivate these customers purely as a summer business, to bring summer loads up as high as the winter. In the discussion, various members cited experiences in specific cases and the benefits secured; it was evident that the rates quoted often had to be 1c. per kw.-hr. or lower to be attractive. A few showed how manufacturers had been able to readjust their processes and hours so that they kept off the lines in peak-hours and so availed themselves of cheap energy. Some argued that several off-peak classes should be formed, as for instance: (1) those using current from 8 p.m. to 3 p.m.; (2) those using current at all times except 5 to 7 p.m., and (3) those using current only in the summer time.

PUBLIC POLICY—The annual report of the Public Policy Committee (Arthur Williams, of New York) as usual was the feature of one evening session to which public attention was stimulated. Gratification was expressed over the general harmony of views of companies and utility commissions; old arguments for unified electric-supply monopoly supplying all kinds of load were reviewed; industrial education of employees at the expense of the companies was recommended; the Association's activity in combating public ownership of utilities was frankly stated. One appendix gave some of the important utility decisions of the year past; another gave the recent recommendations of the Water Power Committee of the Fifth National Conservation Congress, and a review of the Cleveland 3-c. municipal-plant proposal.

Provision for Future Rapid Transit in Cities*

BY J. VIPOND DAVIES†

The term "rapid transit" itself, as applied to the great problem of city passenger transportation, has come to be used with the idea that it will provide the solution of all the difficulties of travel incident to the concentration of population in the great cities, while it is essentially only one element in this great problem.

The development of all big cities of the world has been dependent on transportation. The early cities were, with hardly any exception, built on waterways where the water furnished the means of transportation, and even in the development of New York City, the original city plan was laid out with the east-and-west streets running between the North (Hudson) River and the East River at frequent intervals, because the means of transportation was by those rivers, and the increased facilities for intercommunication from side to side were considered of superior importance to the longitudinal movement which it was then believed would always remain upon the waters of the North River and the East River.

It is impossible in the early days to prophesy what the development of a city will be, and Washington, which is one of the few cities of the world that have been laid out in the beginning on a definite plan, has proved that what was anticipated on the original layout to be the commercial center of the city has developed very differently.

Because the development of a grown city has proved its original plan to be inadequate, it is not by any means an indication that such planning or development has been haphazard. One of the troubles with us is that we are trying to solve in a decade the whole transportation problem of cities which have required hundreds of years to build up.

In the more detailed consideration of the types of structure for providing for rapid transit, the presence of the original steam railroads on private rights-of-way at surface grade must not be lost sight of. One of the first necessities will be the treatment of, or reconstruction of, that steam railroad. All our large cities are actively

*Extracts from a paper read at the National Conference on City Planning, Toronto, May 24, 1914.

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engaged in that work. The proper treatment of these grade-elimination problems is very complicated and largely dependent on local topographical conditions, but the treatment of such should have prior rights over any new development solely for rapid-transit purposes, because the steam-railroad problem is less elastic and much more limited by operating and construction conditions than a purely rapid-transit road handling passenger service.

Generally speaking, it can be assumed that a properly built railroad track, whether on surface right-of-way, or viaduct or steel structure, or in a subway, is capable of doing only the same passenger business, or, in other words, can serve to operate the same number of persons per hour; and, further, that the operation and maintenance, including depreciation and all other charges, will, if a road is doing a reasonably full business, use up about 45% of its gross income, the remaining 55% being available to pay the interest charges on the capital invested.

It, therefore, can readily be seen how important it is with light traffic to keep the cost of construction and equipment low, considering that, for illustration, the Interborough Rapid Transit Subway in New York, consisting in part of subway and in part of elevated structure, must haul more than 2,000,000 pay passengers per annum per mile of single track to meet fixed charges for structure and equipment; or, further, that a road which would cost, for structure alone without equipment, say $500,000 per mile of double track, would have to haul at a five-cent fare 910,000 pay passengers to pay interest charges on its expenditure for that structure, and, if equipment were included, would have to haul probably 1,400,000 pay passengers per annum.

It will help materially in this consideration to have clearly stated the approximate relative costs of producing different structures, and the figures in the accompanying table are given as average costs for construction of structures and the installation of structural equipment, but without power or rolling stock. They do not include the value of property for rights-of-way or easement and are given on the basis of constructing a double-track railroad in each case, although reduced to the cost per mile of single track:

TYPES OF STRUCTURE FOR DOUBLE RAILWAY TRACKS

	Cost per mile of single track
Trolley railroad in suburban district, either on public roads or private right-of-way where no paving is required; complete with overhead trolley construction, track bonded; all in operating condition	$25,000
Trolley railroad on city streets, including asphalt or granite-block pavement for width of tracks and 2 ft. outside of tracks; complete with overhead trolley construction, track bonded; all in operating condition	42,000
Underground trolley railroad in congested streets of a city, including necessary pavements, conduits, etc., and with reasonable allowance for changes of subsurface improvements:	
New York	126,000
Washington	48,500
Elevated railroad of a type and for the loading permissible to meet requirements of Public Service Commission of New York; complete with stations, contact rail, ties and track; averages	125,000
Railroad in open cut similar to Sea Beach R.R. of Brooklyn Rapid Transit Co. in Brooklyn, where work is executed with steam shovel and with concrete walls; averaging cost of bridges and stations as part of the cost; complete with contact rail, ties and track; averages	225,000
Railroad on masonry viaduct filled in with stone ballast, similar to structure now being erected on Queens Boulevard from Queensboro Bridge to Greenpoint, on Long Island, New York; complete with stations, contact rail, ties and track; averages	330,000
Subway such as the Fourth Avenue Subway in Brooklyn, where work is unaffected by subsurface improvements, where the digging is easy and can be done with steam shovel under typical ideal conditions; complete with structural and track equipment; averages	402,000
Subway such as the Broadway Subway now being constructed in New York City, where the work is very difficult and involves extreme interference with subsurface improvements of all kinds, the support of street surface, trolley car tracks, underground trolley construction, etc.; complete with structural and track equipment; averages	1,190,000
Iron-lined tube tunnels under waterways or below water level; complete with structural equipment and track; averages	2,700,000

In connection with the above table of costs, the difference in the first cost of constructing improvements in a city like Washington, where the soil is advantageous to excavate, where the streets are broad and where there is no difficulty in changing subsurface improvements, is in marked contrast to the cost of executing similar work in a city like New York, where the material to be excavated is most difficult, where the streets are congested and where there are numerous and extensive subsurface improvements to be cared for.

In the matter of speed of operation on street surface railroads in congested portions of great cities the average speed does not exceed 8 miles per hour. In the less dense districts of a city this speed is increased to 11 or 12 miles per hour, but the average speed for street-trolley railroads in cities will not exceed 9½ miles per hour. Similar electric-trolley service in outlying districts on private right-of-way will average somewhere between 12 and 15 miles per hour. Local service on elevated railroads or subways or in open cut, with stations approximately 1200 ft. apart, will operate at an average speed of about 15 miles per hour. Express service on subway or elevated railroads or in open cut, with express stops spaced about 2 miles apart, will operate at an average speed of about 25 miles per hour, while steam railroads operating rapid-transit suburban service, with stops at longer intervals, have an average operating speed of 30 to 35 miles an hour, depending on the district served and the frequency of stops.

The spacing of stations on any type of rapid-transit railroad is an important factor as affecting train operation and development of the district. The demand by operating railroad officers, in the interest of the general traveling public, is to increase the length between express stops and so increase the average speed, and, at the same time, to throw increased and more equitable burden on to the local lines. On the other hand, the constant demand by real estate promoters is to ruin the entire high-speed express service by introducing frequent stops on the express lines, thereby, to a large extent, reducing the express service to little better than is provided by the local trains.

For the best operation and to stimulate growth in outlying districts, no high-speed service should have stations at nearer intervals than two miles, in the territory between the concentrated commercial center and the outlying suburban sections.

The increase in travel in relation to the population of cities, as illustrated by New York, indicates the growing necessity for constantly increasing facilities by all classes of transportation service. In New York City in 1860, by all means of public conveyance, there were only 43 rides per head of population per annum. In 1870, this figure had increased to 100; in 1880, to 150; in 1890, to 230; in 1900, to 247; in 1910, to 322; and the most re-

cent figures indicate about 360 rides per head of population per annum during the last year. Somewhat similar figures hold good for Paris, London and Chicago, and to a large extent this increase has been occasioned by the increased transportation facilities provided for the public.

An Investigation of the Puzzolanic Nature of Coal Ashes

The hydraulic properties of cement made of the class of materials called "puzzolana" have long been known, especially when these materials were mixed with lime.* These materials are largely made up of silica and alumina, and in some cases with considerable amounts of iron oxide and lime. A number of artificial puzzolanic materials have been recognized, prominent among which are blast-furnace slags. In examining the composition of various coal ashes (see Table I), a striking similarity has

TABLE I. COMPARATIVE ANALYSES OF PUZZOLANA AND COAL ASHES

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Alkali	SO_3	H_2O
Italian[1]	40-60	10-22	5-30	1-18	0-5	1-11	...	3-9
		22-40						
Azores[1]	55-61	11-20	6-13	2-4	1-2	2-6	...	5-12
		24-26						
French[1]	31-48	33-39		4-8	0-4	0-7	...	2-20
German trasses[1]	46-68	11-23	3-12	1-8	1-3	2-10	...	1-13
		17-33						
Santorin ash[1]	63-73	10-16	4-9	3-4	1-2	3-5	...	1-5
French arenes[1]	39-60	20-30	9-22	2-8	2-8	1-3	...	...
Welsh coal[2]	27	...	...	5	1	...	...	...
		57						
English coke[2]	42	34	5	...	0.3	...	13	...
Illinois coal[3]	27-56	14-24	12-52	2-12	1	...	...	0
		36-66						
Illinois coal[3]	23-40	6-10	13-33	25-55	1-2	...	...	0
		20-42						
Indiana coal[3]	27-45	14-28	20-52	2-5	1	...	...	0
		48-66						
Foreign anthracite[4]	40	42	5	8	1	...	1	...
		48						
Buck Mt. (Pa.)[5]	26	27	43	2	2	...	0.2	...
Pardee coal[5]	44	45	39	5	0.1	...	0.8	...
Ohio Coal Co.[6]	51	23	11	11	0	...	2.5	...
Steam (bitum)[6]	40	24	28	7	1	2	...	...

[1]From Eckel's "Cement, Lime and Plasters."
[2]From Stillman's "Engineering Chemistry."
[3]From Univ. of Ill. Bulletin 43, 1909.
[4]From Eckel's "Cement, Lime and Plasters."
[5]Prof. L. B. Marks, Eng. News, Dec. 8, 1910.
[6]L. P. Crecelius, Am. Elec. Ry. Eng. Assoc., Oct. 7, 1912.

been seen with the composition of the puzzolanic materials noted, and the question at once arises in mind as to whether coal ash has hydraulic properties when made into cement with hydrated lime. If coal ashes should be found suitable as cementitious material, a great use for them might be found in some low-grade construction where cheapness is a great consideration; such mixtures might be of particular use for the foundation of pavements, in rural districts, and there might be many other services, like building mortars, where low cost and wide availability would be important factors. Any deficiency of unit strength of the resulting cement or concrete, compared with the figures secured with higher-grade materials, might be compensated for, in rough work, by increased dimensions. It could not be expected, of course, that such materials would supplant the higher-grade products, but their use might be supplementary.

A series of experiments, as hereinafter outlined, was made at the Engineering College of the University of Vermont, to investigate the possibility of puzzolanic characteristics in coal ash. These experiments were completed by Messrs. N. C. Peterson, J. J. O'Brien, and G. F. Devereaux, in 1913, as part of a thesis for the degree of Bachelor of Science in Civil Engineering. The work was done under the direction of J. W. Votey, Dean, and J. W. Elliott, Professor of Civil Engineering, and in consultation with the editors of ENGINEERING NEWS. The chemical analyses were made by the Department of Chemistry for the investigators.

A much more extended and comprehensive outline of tests was started upon, but the unfavorable results in the early part of the series did not warrant their being carried out as planned.

Tests were made on anthracite and bituminous coal ashes, both fresh and weathered. All fresh ashes were taken direct from certain furnaces, and the weathered ashes were secured from piles where they had been exposd to the elements for approximately a year. In each case, typical samples were secured. All four varieties were not given chemical analysis, but two of them were studied with the results shown in Table II.

TABLE II. ANALYSES OF ASHES SAMPLED FOR STUDY OF PUZZOLANIC NATURE; UNIVERSITY OF VERMONT EXPERIMENTS

	Fresh Bituminous		Fresh Anthracite	
	Sample 1	Sample 2	Example 1	Sample 2
SiO_2	27.25	27.07	47.95	48.21
$Al_2O_3+Fe_2O_3$	30.13	27.00	37.07	39.06
CaO	0.00	0.00	0.00	0.00
MgO	0.00	0.00	0.00	0.00
H_2O	0.00	0.00	0.00	0.00
C	41.01	41.01	Trace	Trace

A comparison of these analyses with the figures for known puzzolanic materials shows, so far as mere constituents go, real similarity. It was not expected, however, that ash containing such a large percentage of unburned coal as was seen in the fresh-bituminous samples would give good results, but the analyses were completed after the tests were started, and the percentage of carbon was not known beforehand. A good grade of factory-slaked lime was secured for use in making up the lime-ash mixtures. This slaked lime analyzed as follows:

	Sample 1	Sample 2
Si_2O_3	0.686	0.641
$Fe_2O_3+Al_2O_3$	0.130	0.160
CaO	67.83	68.80
MgO	0.00	0.00
H_2O	0.82	0.82

The ash samples were ground in a standard (Olsen) ball mill and screening tests were made, but on account of the extreme lightness of the ground material it was found impossible to determine the exact percentage passing through a 200-mesh sieve. (This might have been on account of the mutual attraction of the fine particles electrified. Ash which had once passed through a 200-mesh screen was passed through the second time with a great deal of difficulty, which makes the theory of electrification seem more probable.) At first it was thought that the ball mill was not grinding the ash fine enough, so a pebble mill and hand buck were tried, but with no better results in screening tests. In all cases, the batch was ground for about eight hours in the ball mill, and only that portion passing through a 100-mesh screen, unless otherwise noted, was used in the trials. The ground material gave every indication of being as fine as portland cement and the experimenters were of the opinion that fully 85% was of such a size as to have passed through the 200-mesh screen, except for the interference of balling phenomena.

*Natural puzzolana were described by Edward Duryee, "Eng. News," Aug. 15, 1912, the classification there being given of (1) animal skeleton, (2) tufa deposits from mineral springs, (3) acid-decomposed rocks, (4) infusorial earths.

The mixing of ashes and lime was done by hand. To determine when paste was of the proper consistency in mixing the briquettes, the common laboratory method was used of molding a ball until water appeared on the surface and then dropping this from a height of 20 in.

Samples of the four varieties of ash which had passed a 100-mesh screen were mixed by hand with 25%, 50%, 75% and 100% of hydrated lime, and six briquettes were molded from each mixture. The molds were then placed in the moist closet. At the end of 24 hours they were examined, and it was found that all the briquettes had stiffened slightly but none had taken initial set. The molds were removed and one briquette of each mixture was placed under water, the rest remaining in the closet. After two months, no further action was noted—no initial set being detected.

Ash and lime mixtures ground together in the ball mill showed no better results than when mixed by hand. Briquettes which hardened in air possessed no tensile strength and could easily be broken with the fingers. Sufficient material for a few briquettes was secured passing through a 200-mesh screen and mixed with 50% of hydrated lime, but the results were the same as already noted.

Two briquettes were made from each of the lime-ash mixtures and standard sand (20-30-screen), also from each of the lime-ash mixtures and sand, finely ground in the ball mill. The proportions were one part lime-ash to one part sand. The sand-mixture briquettes were treated in the same manner as the neat-mixture briquettes and the results of the tests were identical. No hydraulic properties seemed to develop.

At this point, the experimental work was stopped on account of the negative results.

The experimenters were thus unable to corroborate such statements as may be found in the Encyclopaedia Britannica; "Good hydraulic mortars may be made from lime mixed with furnace ashes or burned clay as the puzzolanic constituent," nor were they able to discover the authority for this statement.

The possibility should be noted of a connection between the negative results secured in these experiments and the necessary treatment of blast-furnace slag intended for puzzolan cement. These slags, although they may have the correct chemical constituents, are worthless as cementing material unless they are suddenly cooled, and acquire in this way the necessary physical properties.

It is interesting to add that a study of this point has recently been reported by K. G. Ilekevic, Bulletin 2, of the Academy of Sciences of St. Petersburg, Russia. The author's studies of cements lead him to the opinion that high temperature and sudden cooling play the principal and fundamental rule in contributing to siliceous earths their puzzolanic or hydraulic properties.

NEWS NOTES

Salary Reductions in the New York City Department of Bridges have amounted to $109,173 per annum since the present commissioner, F. J. H. Kracke, has been in office.

A Jack Collapsed Under a Three-Story Frame House which was being moved in Elizabeth, N. J., on May 28. The building fell on four men who were under the house adjusting the jacks; one man was killed.

The Explosion in the Sewer Screening Station, Boston—Later information concerning the disastrous explosion in the screen house of the Chelsea St. pumping station of the Metropolitan sewage system in East Boston, Mass., on June 1, places the fatalities at six—three of the injured having died. Up to June 6, no light had been shed on the cause of the accident.

A Proposed Metropolitan Water District, consisting of Oakland, Berkeley, Alameda and four other California cities on the east side of San Francisco Bay was defeated on June 2 by a vote of about 13,500 to 10,700 out of a total registration of about 84,000. The proposition carried no financial obligation nor any other feature than the mere formation of a water district.

Concrete-Bridge Falsework Collapsed, due to a 20-ft. rise in the Leon Creek, at the new county bridge over the creek, on the Palo Alto road, near San Antonio, Texas, on May 21. The falsework supported the concrete arches which are said to have been placed ten days previous to the accident, and not to have been damaged by the collapse of their support. On May 22, the Leon had gone down 8 or 10 ft.

Two Small Frame Buildings Collapsed in Philadelphia on June 2, during alterations. The buildings were 2½ stories high and had not been occupied for some time. According to the Bureau of Building Inspection no permit had been applied for nor granted, for altering the houses.

On the day previous, during a funeral, the floor of another residence in Philadelphia failed, dropping about 20 persons and the coffin into the cellar.

An 80-Year Old Wooden Bridge on the Granville Road over Little River, near Springfield, Mass., known as Horton's Bridge was recently torn down. The old bridge was built in about 1835 and was shown by an investigation to be in a dangerous condition due to weakened timbers. The present abutments will be rebuilt and probably two new piers will be placed in the river to help support a new concrete structure.

A Locomotive Jumped the Track at High Speed, killing five men and injuring three on the Baltimore & Ohio R.R., near Cook's Mills, about 9 mi. northwest of Cumberland on the Pittsburgh division on May 31. The locomotive was carrying a freight crew of six men and an engineman and fireman. The engine had been running about a mile on straight track at a speed of over 60 mi. per hour when it left the track, rolled over an embankment and dropped into a field bottom up.

The Federal Aid Road Appropriation Bill of $25,000,000, which passed the House of Representatives on Feb. 10, by a vote of 284 to 42 is in danger of being materially reduced. A sub-committee of the Senate Post Office Committee proposes to cut the appropriation to $5,000,000. The Shackleford bill appropriating $25,000,000, distributed on over a million miles of roads as proposed, amounted to about $15 per mile, so the new bill will be only $3 per mile, or equivalent to the labor of one man one day.

A Steamer Struck the Draw Span of the Madison St. Bridge, in Chicago, Ill., on May 30, carrying away part of the railing and sidewalk. A number of persons on the bridge at the time were knocked down, but none was hurt. Temporary trouble in the bridge machinery prevented the turning of the span. Just as the draw span started to move, the freight steamer "Susquehanna" of the Anchor Line towed by a tug crashed into it. The ship was not damaged, and moved on as the bridge gave way before it.

The Corrected List of Casualties by the sinking of the "Empress of Ireland" shows that the total number of persons sailing from Quebec on the vessel was 1479, of which 1027 were lost and 452 were saved. The casualties among the passengers and crew were as follows:

	No. sailing	No. lost	No. rescued
First class	92	56	36
Second class	256	209	47
Third class	718	582	136
Crew	413	180	238

The Chicago Railway Terminal Commission, provided for by the new ordinance for the reconstruction of the Union Station, and noted recently in our columns, is constituted as follows: John F. Wallace, engineer for the council committee on local transportation, and Alderman Ellis Greiger, chairman of that committee; Bion J. Arnold, engineer and Walter L. Fisher, attorney, representing the Citizens Terminal Committee; E. H. Bennett, representing the Chicago Plan Commission; L. A. McGann, Commissioner of Public Works; and W. H. Sexton, Corporation Counsel. The commission is to investigate the railway terminal problem of the city and to make its first report by Jan. 1, 1915.

City Plans a Union Railway Terminal—Under legislative authority, the city of Minneapolis, Minn., is working out plans for a union depot, to be used by all the railways entering the city. The central feature of the plans is an enlargement of the new Great Northern Ry. terminal to twice its present size and trackage, giving it a minimum of 24 terminal tracks and room for a possible future railway office-

building. Extensive adjustment of trackage connections and freight-house facilities is necessarily involved, to clear the required site and at the same time give the individual roads freight facilities equal to or better than their present ones. F. W. Cappelen, City Engineer, has the matter in charge. Negotiations over the plans are pending.

"Overhead Charges" covering all "proper and fair allowances for engineering and superintendence, insurance, taxes and legal expenses, interest during construction, financing and development cost, are grouped under "intangibles" by the Ohio Public Service Commission in considering appraisals of the property of the Bucyrus Light & Power Co. Their allowance for all intangibles was $14,000 or about 19%. The original intangibles, corresponding to original or reproduction cost of tangible plant, were $18,000 and this was depreciated just as was the physical property. What are commonly called "intangible values," including early deficits, etc., seem not to have been allowed; it is stated that if development would cost $20,000, then little of that sum could be shown as present business is not yet developed.

Six Men Were Overcome by Gas on the Tank Steamer, "San Valerio," which arrived at Galveston, Tex., on May 31, with a cargo of crude oil from the Tuxpan fields in Mexico. According to the crew the chief carpenter of the ship went down into the forepeak to make repairs to one of the bilge pumps, on May 28. The entrance to the forepeak is by means of a manhole about 2 ft. in diameter. When about half-way down the ladder the carpenter was seen by his helper to let go suddenly and fall. The helper started downward and was in turn overcome. Chief officer P. F. Elliott was next to go and he was followed by three other men, all of whom were overcome. The six bodies were finally recovered by using a smoke hemlet. The fatal compartment was not used for oil storage, and it was not known how the fumes gained entrance into it.

An Ozone Plant for Water Treatment is a feature of the equipment of the new office building of the Chicago, Burlington & Quincy R.R., in Chicago. The plant has capacity sufficient for water supply for some 3000 persons, and has been in operation about ten months. The design and installation were left to the contractor, the Held Co., of Chicago, under guarantee that the plant would operate to the satisfaction of the railway company's officers. The water from the city main is passed through two Roberts mechanical filters, which can be run in series or parallel, according to the degree of filtration required. The water then passes through a disk type International filter and into the cooling tank. The ozone is introduced to the system in the return main to the cooling tank, so as not to be dependent on the flow of the make-up water. The daily consumption of drinking water is about 4000 gal.

High Winds Destroyed a Large Cattle Pavilion at the Wisconsin State Fair Grounds on May 31. The pavilion was built two years ago, of concrete blocks and steel. It was 100x200 ft. in plan, valued at $50,000 and insured for $31,500. It is stated that not a section of wall more than 6 ft. high remained standing. Small sections of the slate roof which was supported on steelwork, are intact but most of the slate was broken.

Many washouts occurred in the streets of Milwaukee. Sewers were choked and cellars flooded. Two 60-ft. brick chimneys of the plant of the Kearney & Trecker Co. were blown down. In falling they demolished a blacksmith shop. An unfinished flat building collapsed. It is said that ⅞-in. boards from a building of the International Harvester Co. were blown against the 15-in. wall of another building 100 ft. away, through which they penetrated about 2 ft.

A Timber Highway Bridge Burned, which spanned the Mystic River between Somerville and Medford, Mass., on June 6. A steel draw span which formed part of the bridge was weakened by heat and dropped into the river. It is supposed that the fire was caused by sparks from an electric cable carried under the bridge. The burned section was about 500 ft. in length. The bridge was 900 ft. long by 70 ft. wide, and carried two electric car tracks, two 6-ft. sidewalks and a wide road, paved with wood blocks. The Wellington Bridge is on the main route from Boston to Middlesex Fells and the Revere Beach boulevard. At least three hours passed before the firemen of Medford, Somerville and Everett were able to place the fire under control and it was not until high tide at 6:15 p.m., that fireboats from Boston were able to reach the scene and direct effective streams of water upon the blaze. The nearest land hydrant was about a quarter of a mile distant from the bridge. The damage is estimated at $100,000, and in addition there is the interruption to travel between Somerville, Medford and Boston.

Electric Switching Locomotives of the New York, New Haven & Hartford R.R. continue to yield favorable results. All the switching has been so done in the Harlem River yards, New York City, for 18 months. In some of these yards where car floats are loaded and unloaded the service is difficult. So far the officials find the electric switches superior in every way—control, stand-by losses, freezing, etc. Six units do the work of twelve steam locomotives and eight handle all the freight from the river to Stamford, Conn., and these are kept in service 24 hours a day covering some 140 miles (with three crews). A typical total of monthly mileage (six in a yard only) was about 33,000, and energy taken at the locomotives, 896,000-kw.-hr.; 65,000 cars were shifted through of a total weight of 1,000,000 tons.

The company has 16 switching locomotives, each with four 125-hp., 25-cycle motors. The weight is 80 tons each and maximum tractive effort 40,000 lb. At 6 mi. per hr. an effort of 36,000 lb. can be developed for three minutes. The continuous effort is 14,800 lb. at 11.5 mi. per hr.—From "Electric Railway Journal," May 23, 1914.

The Wisconsin State Building Code, which was published for discussion two months ago by the Industrial Commission of the state is likely to be in final shape in about two months. As a result of its publication, and public hearings in various cities, a great many detail comments were received by the commission. These will be studied and a number of them probably used to improve the code. The general plan of the code is not attacked by the criticisms, however, and in its final form it will doubtless be similar to the tentative draft; a set of provisions bearing on fire protection and sanitation mainly, with a short and very general chapter on construction. The code concerns itself only with "places of employment and business buildings"; these terms are so defined as to exclude dwellings, private stables, apartment buildings, houses not more than two families, and lodging houses with less than six lodgers. The intention is that the local officials of cities shall administer the code, no administrative machinery being as yet contemplated by the commission. S. J. Williams, Deputy in charge of Buildings, is handling the detail work on the code for the commission. An advisory board of architects and others assists.

A Decade of Panama Canal History—Ten years of American occupation of the Canal Zone were completed on May 4, 1914, the transfer of Canal property from the second French company to the United States having been effected on May 4, 1904. The three first years of the American occupation were devoted principally to preparation. Excavation in the Culebra Cut section, continued from the first with such equipment as was available, was not well under way on the American plan until the first part of 1907; and the only dredge at work up to May 20, 1907, was the old French ladder dredge "Mole," maintaining the channel between the ocean and the steel wharf at Balboa.

The decade has seen the virtual completion of the Canal, and the beginnings of its commercial and naval use. During the past year, the sea-level channels have been opened to Gatun and Miraflores Locks; Gatun and Miraflores Lakes have been filled to normal height; Culebra Cut has been flooded; all of the locks have been operated repeatedly; and a number of vessels in the Canal service, as well as several rafts of piles under tow, have passed from ocean to ocean through the Canal.—"Canal Record," May 20.

A Boat Propelled by an Air Propeller has been built by an English firm for use on a river in Demerara and is described in "The Engineer" of London. The vessel is a barge 30 ft. in length with 10-ft. beam. The propelling machinery consists of a 15-hp. oil engine driving by a high-speed chain drive a 9-ft. diameter air propeller at a velocity of 1200 r.p.m. Our contemporary states that a thrust of 200 lb. has been obtained from the propeller and that the tug has an average speed of five miles per hour. Under these conditions if the engine develops 15 effective horsepower, something less than 3 hp. is applied to the propulsion of the vessel and the remaining power is expended in friction and in driving the current of air astern. Our contemporary also states that this vessel is to be used as a tug and is to tow from sixteen to twenty barges of similar design to herself with a displacement of about 4½ tons each when loaded to 8-in. draft and that this whole fleet is to be towed up a narrow channel with a maximum depth of only 13½ in. and a width of only 18 ft. Under these conditions the very small effective thrust of the propeller will be divided up among such a considerable number of vessels that it will probably be necessary to set up stakes on the bank to make certain that the fleet moves at all.

Necessity for Condemnation and compensation for seizure of property for public utilities must be determined by the Vermont Public Service Commission for that state, according to the decision of the state supreme court in the case of George vs. Consolidated Lighting Co., recently decided. The

public-utility law provides that when it is necessary to meet reasonable demands for service, pipe lines, conduits, pole and wire lines may cross the lands of any person, and that where agreement cannot be reached between parties, the company may petition the Public Service Commission to determine the necessity and compensation. This decision is final, subject to the review of the state supreme court. This procedure was attacked on the grounds that this section of the law was unconstitutional and that the company's charter antedated the law.

The court's opinion was to the effect that some impartial tribunal must decide necessity and compensation and provision of a Public Service Commission met the constitutional necessities requiring only that the proceeding be conducted in some fair and just manner, with opportunity to the owners of the property to present evidence as to the value and to be heard thereon. The court also held that the "judgment" to be rendered was a "decision" within the powers of an administrative body and not a judicial pronouncement. Nor was the fact of charter antedating law held to prevent the contested possession being applicable.

PERSONALS

Mr. W. L. Jack has resigned as Treasurer of the Riter-Conley Manufacturing Co., Pittsburgh, Penn.

Mr. R. F. McCloskey, Shop Manager of the Riter-Conley Manufacturing Co., Pittsburgh, Penn., has resigned.

Mr. W. T. Kuhn, formerly Master Mechanic of the Toronto, Hamilton & Buffalo Ry., has been promoted to be Superintendent of Motive Power at Hamilton, Ont.

Mr. William Floyd Lee, M. Am. Soc. M. E., Chief Engineer of the C. W. Hunt Co., West New Brighton, N. Y. has been elected Vice-President and Chief Engineer.

Mr. K. Nakamura, Chief Civil Engineer of the Imperial Government Ry., of Tokio, Japan, is visiting in this country to inspect American railway structures and operation.

Mr. D. F. Kirkland, Superintendent of the Atlanta, Birmingham & Atlantic R.R., has been appointed General Manager of Georgia & Florida Ry., succeeding Mr. B. W. Duer, resigned.

Mr. Morton F. Sanborn, Assoc. M. Am. Soc. C. E., Civil and Sanitary Engineer, of Pleasantville, N. Y., has been appointed Assistant Sanitary Engineer of the New York State Department of Health.

Mr. H. O. Halsted, Assistant to the General Manager of the Pere Marquette R.R., has been appointed Superintendent of Transportation to succeed Mr. X. H. Cornell, resigned, as noted below.

Mr. X. H. Cornell has resigned as Superintendent of Transportation of the Pere Marquette R.R., Detroit, Mich., to become Master of Transportation of the Chicago & Alton R.R., at Bloomington, Ill.

Mr. W. Creighton Harris, Assoc. Am. Inst. E. E., has resigned as a member of the engineering firm of Creighton Harris & Co., to become Chief Engineer of the Titan Storage Battery Co., of Newark, N. J.

Mr. G. W. Alden has been appointed Manager of the Chicago, Ill., office of the Norbom Engineering Co., designers and builders of hydraulic dredges, of Philadelphia, Penn. A branch office, also under Mr. Alden's management, has been established at St. Louis, Mo.

Mr. Harry W. Terrell, for the past 15 years connected with railway and hydro-electric projects in South America has been appointed Chief Engineer of the Cliffside R.R., Cliffside, N. C., which is controlled by English capitalists. He expects to complete his work in North Carolina by November, when he will return to South America.

Sir William Willcocks, former Consulting Engineer to the Turkish Government, has been appointed a Consulting Engineer of the United States Reclamation Service, and is now on a tour of inspection of the various irrigation projects in the West. A brief biographical sketch of Sir William Willcocks was published in our personal columns of Mar. 12, 1914.

Mr. J. S. Brown, M. Am. Soc. C. E., whose promotion from Division Engineer to be Assistant Engineer, office of the Engineer of Maintenance-of-way, New York, New Haven & Hartford R.R., is noted elsewhere, was born in Pennsylvania in 1861 and began his engineering experience in 1880 as a chainman on the Yellowstone division of the Northern Pacific Ry. He joined the staff of the New York, New Haven & Hartford R.R. in 1889 as a transitman.

Messrs. C. S. Izant and A. M. Frink have formed a partnership under the firm name of Izant & Frink, Architects and Engineers, with offices at 913 Illuminating Bldg., Cleveland, Ohio. Both members of the firm have been connected with the design and construction of the plants of the National Lamp Works in Cleveland, Providence, R. I., Minneapolis, Minn., St. Louis, Mo., and other cities. The new firm will specialize in factories, power plants and other industrial work.

Mr. L. D. Cornish, M. Am. Soc. C. E., of Chicago, Ill, has been appointed Principal Assistant Engineer of the Board of Consulting Engineers on Chinese Flood Prevention, the appointments to which were noted in our issue of last week. Mr. Cornish was formerly Designing Engineer for the Isthmian Canal Commission, at Culebra, C. Z., Panama. Other members of the engineering staff are Messrs. Judson B. Bond, Assoc. M. Am. Soc. C. E., former Project Engineer, U. S. Reclamation Service, Fort Shaw, Mont., and R. J. Newell, Assoc. M. Am. Soc. C. E., of Boise, Idaho.

Mr. W. A. Thomas, for several years Commercial Engineer in charge of sales of mining apparatus for the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Penn., has resigned to enter private practice as Consulting Engineer, with offices in the Second National Bank Bldg., Pittsburgh. Mr. Thomas is a graduate of Pennsylvania State College, class of 1898, and for some time was with the power and mining department of the General Electric Co., Schenectady, N. Y. For two years he was in charge of the power equipment of the Pennsylvania Coal & Coke Co., at Cresson, Penn.

The New York, New Haven & Hartford R.R. announces the following promotions in the engineering department: Mr. J. S. Browne, Division Engineer at Providence, R. I., has been appointed Assistant Engineer, office of the Engineer of Maintenance-of-way, New Haven, Conn.; Mr. W. T. Spencer, Assoc. M. Am. Soc. C. E., Division Engineer at Waterbury, Conn., has been transferred to Providence, R. I.; Mr. Paul Sterling, Division Engineer at Hartford, Conn., has been transferred to Waterbury, Conn.; Mr. W. D. Warren, Division Engineer of the Central New England Ry., Hartford, Conn., has been appointed Division Engineer of the Midland division at Hartford, and Mr. H. E. Astley, Track Supervisor at Boston, Mass., has been appointed Division Engineer of the Central New England Ry., at Hartford.

Mr. Edward Carlos Carter, M. Am. Soc. C. E., has resigned as Chief Engineer of the Chicago & Northwestern Ry. Mr. Carter has not been the active head of the engineering department since a year ago, when he withdrew to devote his whole time to the physical valuation work of the company. Mr. Carter was born at Waverly, Ill., Jan. 11, 1854, and graduated from Rensselaer Polytechnic Institute in 1876. He has been draftsman and Mechanical Engineer of the Springfield Iron & Steel Co., Springfield, Ohio; Assistant Engineer of the Chicago & Alton R.R.; Assistant Engineer, U. S. Mississippi River Commission; Assistant Engineer of Construction of the Indianapolis, Decatur & Springfield Ry.; Resident Engineer and Assistant to the Chief Engineer of the Wabash, St. Louis & Pacific Ry.; Contracting Engineer of the Detroit Bridge & Iron Works, Detroit, Mich.; and from 1887 to the present time with the Chicago & Northwestern Ry., first as Principal Assistant Engineer, and since 1899, as Chief Engineer.

Mr. Mark R. Daniels, Assoc. M. Am. Soc. C. E., Civil and Hydraulic Engineer, of San Francisco, Calif., has been appointed Landscape Engineer and General Superintendent of National Parks, Department of the Interior. This is a new position, which Secretary Lane has considered essential to an economic administration and proper development of the national parks. Mr. Daniels has recently completed an investigation in the post-graduate department of Harvard University upon the subject of the economic value of art. He is 33 years old and a graduate in civil engineering of the University of California, class of 1905. For a short time he was in mining work and afterward with the engineering department of the Southern Pacific Ry. Before opening an office in San Francisco as civil engineer and expert in city planning Mr. Daniels was Assistant City Engineer of Potlatch, Idaho. During his practice in San Francisco he has had charge of landscape work for the Spring Valley Water Co., the Crocker properties, and has been Chief Engineer of the Monterey, Fresno & Eastern Ry.

OBITUARY

Thomas H. Perry, former Civil Engineer with the Lake Erie & Western R.R., died in Tucson, Ariz., at the age of 82 years.

Sewall Truax, M. Am. Inst. M. E., died June 2, in Chicago, Ill., from a bullet wound inflicted by himself on May 7. He was formerly in mining work in Colorado.

Alexander E. Orr, President of the old Rapid Transit Commission of New York City in the early days of rapid-transit development, died at his home in Brooklyn, June 3, aged 84 years.

Dr. Samuel C. Benedict, President of the State Board of Health of Georgia, died in Macon, Ga., June 1, from apoplexy. He was born in Connecticut in 1856 and graduated from Miami Medical College in Cincinnati, Ohio, in 1878.

Charles M. Bird, one of the engineers who accompanied the famous Collins expedition to Brazil in 1878, to build the Madeira & Mamoré Ry. at the headwaters of the Amazon River, died in Wilmington, Del., June 4, at the age of 82 years. During the Civil War he served in the United States Navy as an Ensign. Following the war he was for several years with the engineering department of the Pennsylvania R.R., resigning to join the ill-fated Collins Bros. expedition to San Antonio, Brazil, in 1878. Later he was in charge of harbor development work for the government of Colombia.

ENGINEERING SOCIETIES

COMING MEETINGS

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.
June 15-17. Annual convention at Atlantic City, N. J. Secy., Jos. W. Taylor, 1112 Karpen Building, Chicago, Ill.

AMERICAN SUPPLY AND MACHINERY MANUFACTURERS' ASSOCIATION.
June 15-17. Annual convention at White Sulphur Springs, W. Va. Secy., F. D. Mitchell, Woolworth Building, New York City.

SOUTHWESTERN WATER-WORKS ASSOCIATION.
June 15-17. Annual meeting at Tulsa, Okla. Chairman of Arrangements, L. L. Ballard, Tulsa, Okla.

TRAIN DISPATCHERS' ASSOCIATION OF AMERICA.
June 16-19. Annual convention at Jacksonville, Fla. Secy., John F. Mackie, 7122 Stewart Ave., Chicago, Ill.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
June 16-19. Spring meeting at St. Paul and Minneapolis, Minn. Secy., Calvin W. Rice, 29 W. 39th St., New York City.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.
June 17-20. Sixth semi-annual meeting at Troy, N. Y. Secy., J. C. Olsen, Polytechnic Institute, Brooklyn, N. Y.

SOCIETY OF AUTOMOBILE ENGINEERS.
June 23-26. Annual convention at Cape May, N. J. Chairman of Arrangement Committee, Arthur B. Cummer, 1790 Broadway, New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
June 23-26. Thirty-first annual convention at Detroit, Mich. Secy., F. L. Hutchinson, 29 W. 39th St., New York City.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.
June 23-26. Annual meeting at Princeton, N. J. Secy., Henry H. Norris, 29 W. 39th St., New York City.

AMERICAN SOCIETY FOR TESTING MATERIALS.
June 30-July 3. Seventeenth annual meeting at Atlantic City, N. J. Secy., Edgar Marburg, University of Pennsylvania, Philadelphia, Penn.

AMERICAN SOCIETY OF ENGINEERS, ARCHITECTS AND CONSTRUCTORS.
July 3-4. Convention at Brighton Beach, L. I. Secretary, T. Hugh Boorman, 520 E. 20th St., New York City.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.
July 9-11. Semi-annual meeting at Cleveland, Ohio. Secy., J. J. Blackmore, 29 W. 39th St., New York City.

OHIO ELECTRIC LIGHT ASSOCIATION.
July 16-19. Annual convention at Cedar Point, Ohio. Secy., D. L. Gasgill, Greenville, Ohio.

International Association of Municipal Electricians—The next convention of the Association wil be held Sept. 15-18, at the Hotel Islesworth, Atlantic City, N. J. The secretary is Clayton W. Pike, Electrical Bureau, City of Philadelphia, Penn.

Western Railway Club—At the annual meeting of this Chicago association on May 12, officers were elected as follows: President, E. W. Pratt, Assistant Superintendent of Motive Power, Chicago & Northwestern Ry.; Vice-Presidents, H. H. Harvey (C., B. & Q. R.R.) and J. H. Tinker (C. & E. Ill. R.R.); Secretary and Treasurer, J. W. Taylor, 390 Old Colony Building, Chicago.

Pacific Northwest Society of Engineers—The annual convention will be held in Seattle, Wash., June 19-20. The 19th will be devoted to the President's address, presentation of technical papers, and the annual banquet. On the 20th, a trip will be made to Lake Keechelus, in the Cascade Mountains, where the U. S. Reclamation Service is constructing a dam for irrigation purposes.

New York Electrical Society—At the annual meeting of the Society held at the Engineering Societies Building, New York, on June 10, the following officers were elected: President, Frederick A. Scheffler; Vice-Presidents, Bernard Downtree; Geo. Weiderman, Sr., O. A. Kenyon; Secretary, Geo. H. Guy; Honorary Treasurer, Jas. H. McGraw; Treasurer, Henry J. Hoeltge. Following the election of officers, Wm. T. Kennedy spoke on "Electric Vehicles in New York City."

Colorado Association of Members of the American Society of Civil Engineers—The annual meeting of the Association will be held at the Albany Hotel, Denver, on the evening of June 13. It will be preceded by the usual informal dinner. Henry Reed, President of the Art Commission, will speak on "Art in the Training of an Engineer." No meetings will be held during July or August, but the regular Wednesday luncheons at the Colorado Electric Club will be continued throughout the summer. The secretary is Roger W. Toll, 700 Tramway Building, Denver, Colo.

The Northwestern Road Congress, which is to be held at Milwaukee, Wis., Oct. 28 to 31, is the outgrowth of informal conferences of men who are working for good roads in Michigan, Illinois, Iowa, Wisconsin, Minnesota, North Dakota and South Dakota. The problems of these states are very similar, and the conditions of soil and climate do not differ greatly. It is the purpose of the Northwestern Road Congress to bring together the leading engineers, public officials and good-roads organizations of these states and attempt to formulate the basic principles of good legislation, efficient administration and economical construction.

The President is T. R. Agg (Professor of Highway Engineering at the University of Iowa), Ames, Ia.: Secretary, James P. Keenan, Milwaukee, Wis.

National Conference on City Planning—Immediately after the close of the Sixth National Conference on City Planning held at Toronto, Ont., May 25-27, the Executive Committee decided that active and systematic investigations along the following lines should be pushed during the year, in preparation for the next conference: (1) To obtain reliable and comparable data for determining the effective size and distribution of playgrounds and the kindred recreation facilities; (2) To secure the drafting of a comprehensive outline of the powers, duties and administrative procedure in matters of town planning best calculated to serve the interests of the community, with a broad regard for the personal and property interests of the individuals; (3) To assemble data and define principles in regard to the design of subdivisions with a view to the most effective utilization of private property. These lines of work will be pursued under small committees who will endeavor to secure the opinion of every member of the Conference who will coöperate. The chairman of the Executive Commiteee is Frederick L. Olmsted, Brookline, Mass. The secretary of the Conference is Flavel Shurtleff, 19 Congress St., Boston, Mass.

Western Society of Engineers—At the meeting of the Municipal and Hydraulic section, held at the Society's rooms at Chicago, May 18, there were several addresses on the subject of "The Disposal of City Wastes," and a number of lantern slides were shown illustrating plants and methods in this country and in Europe. Mr. Osborn, of Toronto, Canada, pointed out that the matter of waste disposal is becoming more and more a problem for engineers. Mr. Featherstone, of New York, suggested that engineers will soon look to the ashes as a means of profit, since in New York these contain 20 to 30% of unscreened and unburned coal, while in Chicago the percentage is 34%.

Mr. Pritchard, of Chicago, referred to the general use of motor trucks for garbage and refuse collection in Europe. The engineer in any municipality must study the materials and the conditions which affect handling, transportation, disposal and utilization. The main point is to obviate nuisance and unsanitary conditions. A secondary consideration is the making of a profit from the material. Mr. Allen, Chicago, thought an ideal disposal plant would combine the best features of incineration and reduction systems. The sentimental objections must be reckoned with, and it is difficult to persuade people that the disposal plant and the transportation of waste material will not be a nuisance. Mr. Greeley, Chicago, thought that proper connection should be the first consideration, as failure to remove garbage is such a general subject of complaint.

At the regular meeting on June 1, a paper on "Characteristic Curves of Centrifugal Pumps" was presented by F. W. Greve, Jr.